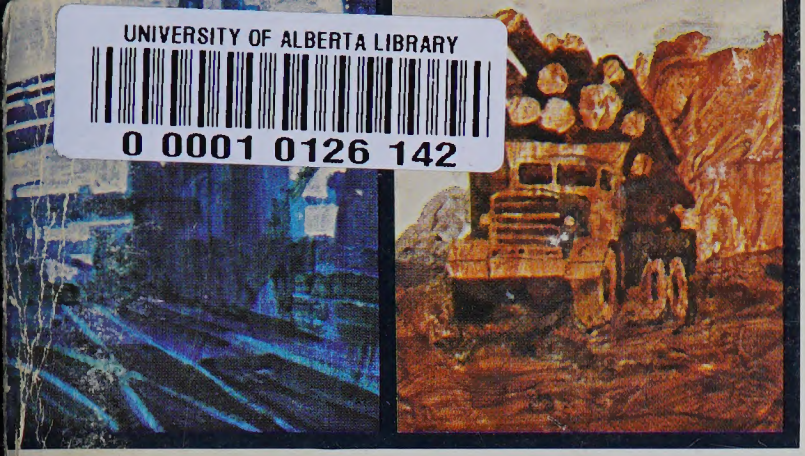
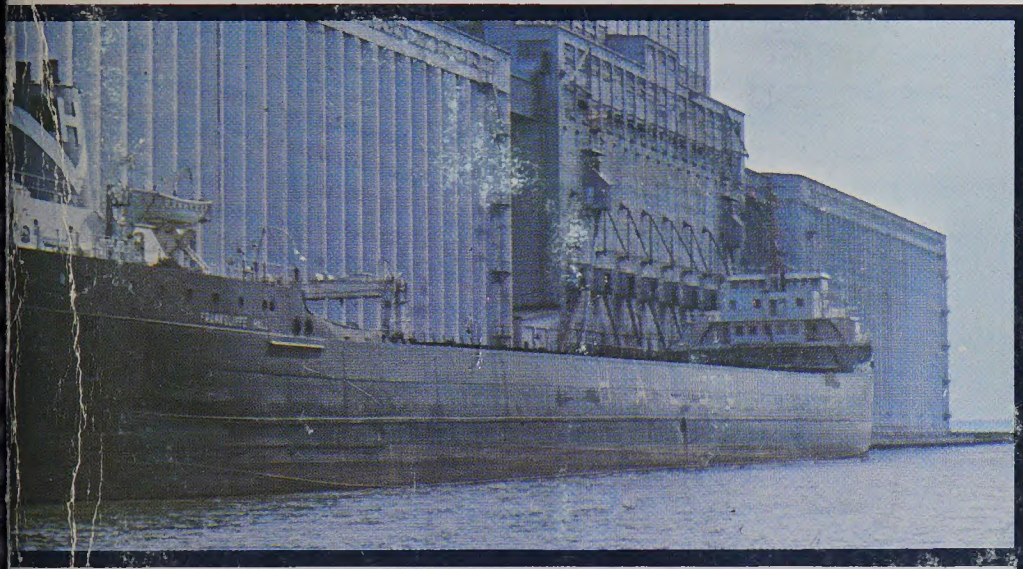
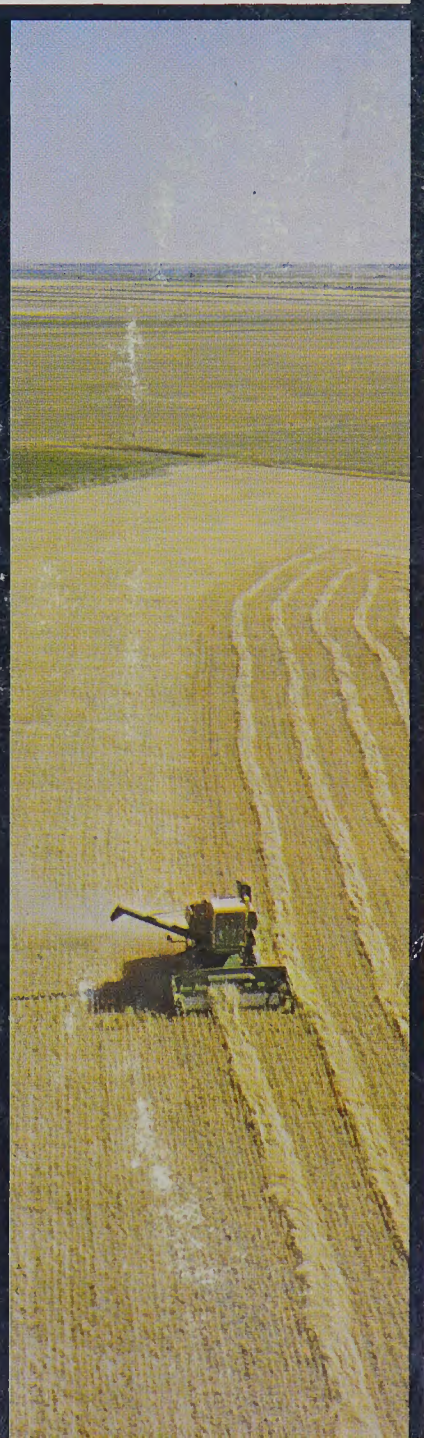


PORT ALBERNI:

PULP AND PAPER





People and Places in Canada

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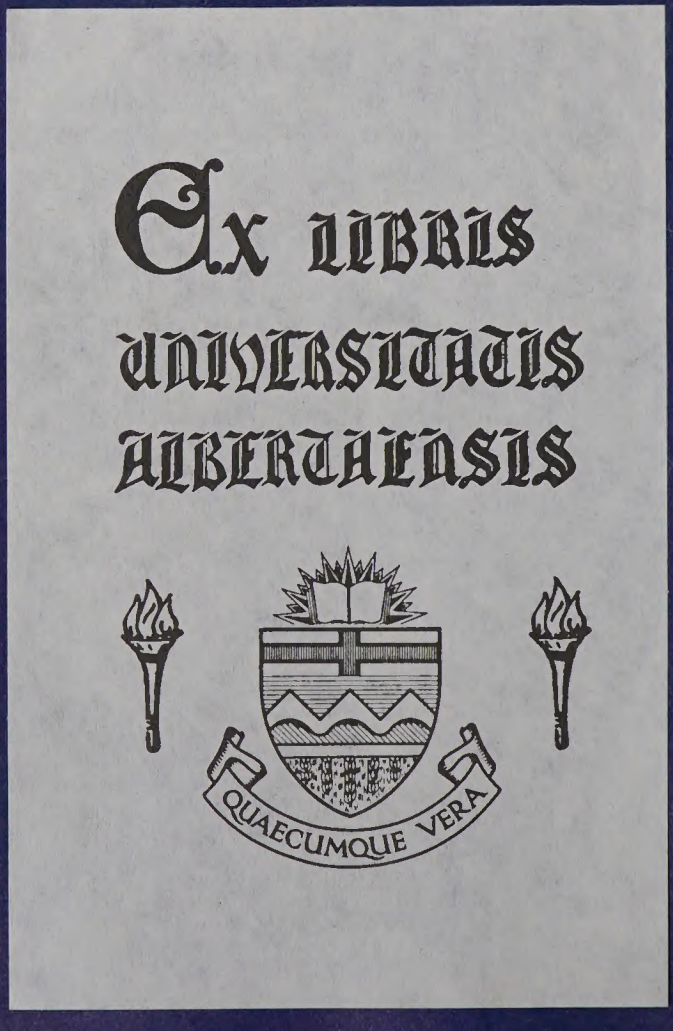
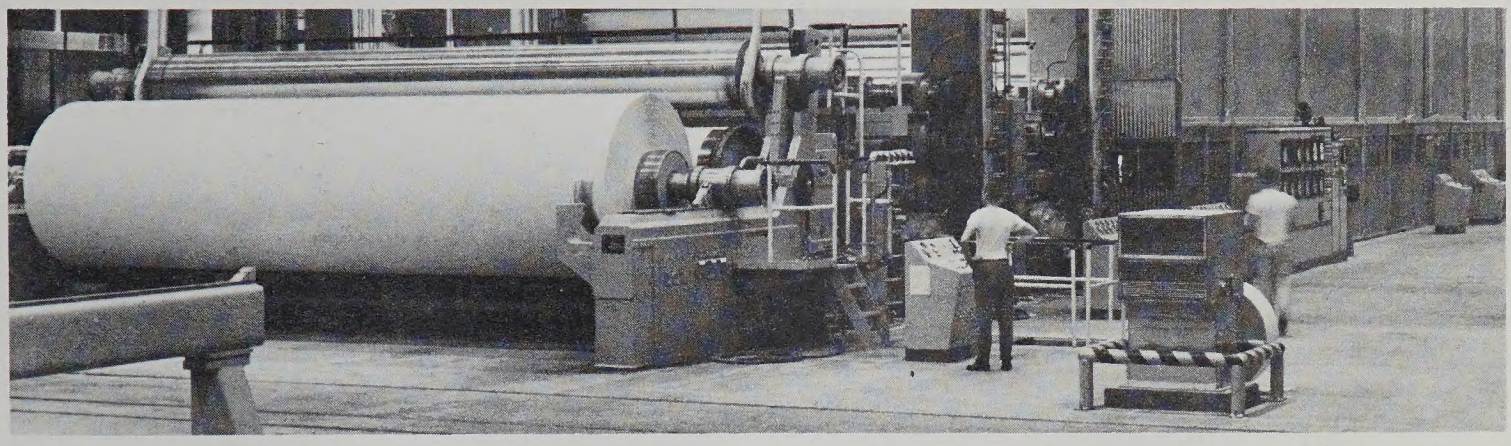


Port Alberni:

Pulp and Paper



A sample study of the pulp and paper industry in Port Alberni, B.C.
An inductive approach.

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Table of Contents

1 What is Port Alberni Like?

Getting There

We want you to meet Mr. Hartt. We would like to take you to his home and introduce you to his family — not forgetting the dog and the cat. But first, you must go on an interesting journey.

Take off from Burrard Inlet, Vancouver, in a small floatplane. Climb steeply, and then steady on a north-westerly course. Below you is the blue-grey water of the Strait of Georgia, but ahead lie the forested cloud-capped mountains of Vancouver Island. Fly on the same course at 120 m.p.h. for forty minutes or so. Soon, through your cockpit window you see ahead and five thousand feet below you, the scene shown as Figure 1 of this book. To avoid tall obstacles, ships, jetties and objects in the water, you had better "land"—or perhaps we should say "splash down"—towards the northern end of this inlet.

Exercise

1.
What tall obstacles and what objects in the water shown in Figure 1 would you have to avoid in "splashing down"?

Opposite
Figure 1

2.
If the smoke from the stacks is blowing towards the north, in which direction do you think your pilot would fly in coming in to "splash down"?

3.
By the way, can you guess where you are? What's the name of this place in which Mr. Hartt and his family live? You were right! This is Port Alberni.

4.
Have you any idea how big it is?

5.
How would you find out if you don't already know? It stands on the south-west bank of what Mr. Hartt would call the Alberni Canal. Strictly speaking this is not a canal, and if you looked it up on a larger scale map you would find that it goes by another name. Why?

6.
From Figure 2 find how far it is from Port Alberni to the city or town where you live.

7.
How far is Port Alberni from Vancouver?

8.
How would you get to Vancouver from Port Alberni?

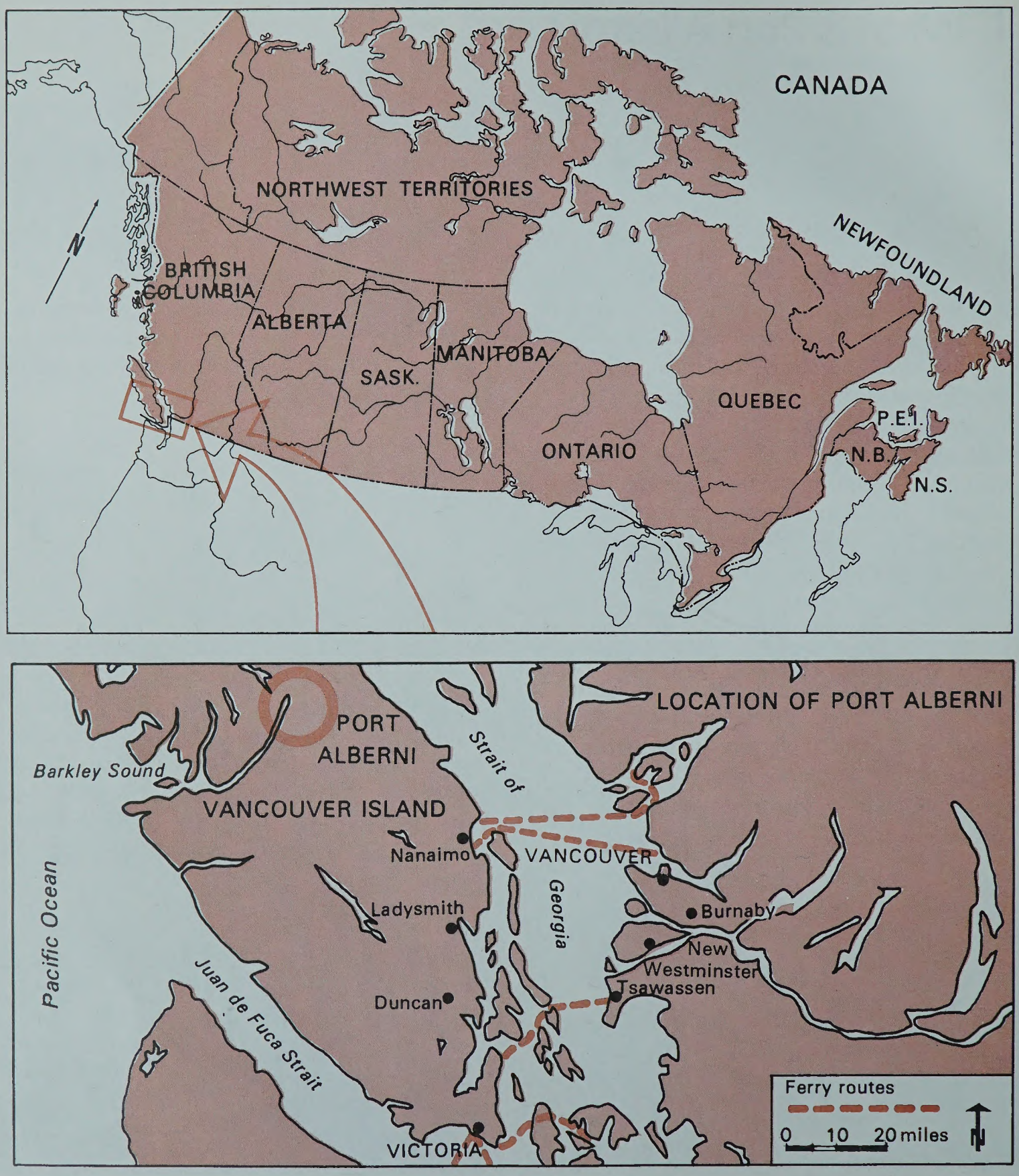

CANADA
NORTHWEST TERRITORIES
N
BRITISH COLUMBIA
ALBERTA
SASK.
MANITOBA
ONTARIO
QUEBEC
NEWFOUNDLAND
P.E.I.
N.B.
N.S.
LOCATION OF PORT ALBERNI
PORT ALBERNI
Barkley Sound
VANCOUVER ISLAND
Strait of Georgia
Nanaimo
VANCOUVER
Ladysmith
Burnaby
New Westminster
Tsawassen
Duncan
Pacific Ocean
Juan de Fuca Strait
VICTORIA
Ferry routes
0 10 20 miles
N

Figure 2

Figures 3 and 4 are sections of a diagrammatic topographical map on scales of 1:250,000 and 1:50,000 respectively. A scale of, for example, 1:50,000, means that any inch, centimeter, yard, or meter on the map represents 50,000 inches, centimeters, yards or meters on the ground. We can put this another way if we like, and say that one inch on the map represents about eight-tenths of a mile on the ground. Every one and a quarter (1¼) inches on the map represents one mile on the ground. 1:250,000 indicates that every inch on the map represents approximately 4 miles on the ground.

Exercise

Look at Figure 3 and answer the following questions.

1.
How far is it in miles from the northern boundary to the southern boundary of Figure 3?

2.
Correspondingly, how far is it from east to west?

3.
Would the country represented in Figure 3 fit inside the area marked off by the circle on the inset in Figure 2?

4.
Look carefully again at Figure 3. Does the map suggest to you that rainfall must be fairly heavy here?

5.
Can you find two seaplane bases marked on this map?

6.
The shaded area of the map, Figure 3, represents those areas which would be coloured green on proper topographic maps. What do you suppose this represents in real life? Try to look at a topographic map of the Port Alberni area at, for example, a scale of 1:250,000, to see what else topographic maps can tell you about the area.

7.
How many times can you find the word Lookout *on this map? What sort of lookouts would these be, do you think?*

8.
Notice the route followed by the CPR and the only hard-surfaced all-weather road.

Mountains occupy the northeastern and the southern areas represented on this map. The area around the head of Stamp River, Somass River, Alberni Inlet, and Sproat and Great Central Lakes is lowland.

Exercise

1.
How would you know this? Look at this area on a proper topographic map. Notice elsewhere the height of the mountains, especially those on the eastern margins of the area shown here.

2.
Can you find any names of places which seem to you to be French or Indian? By looking at the place names, can you guess the nationality of many of those who first travelled across or settled in this area?

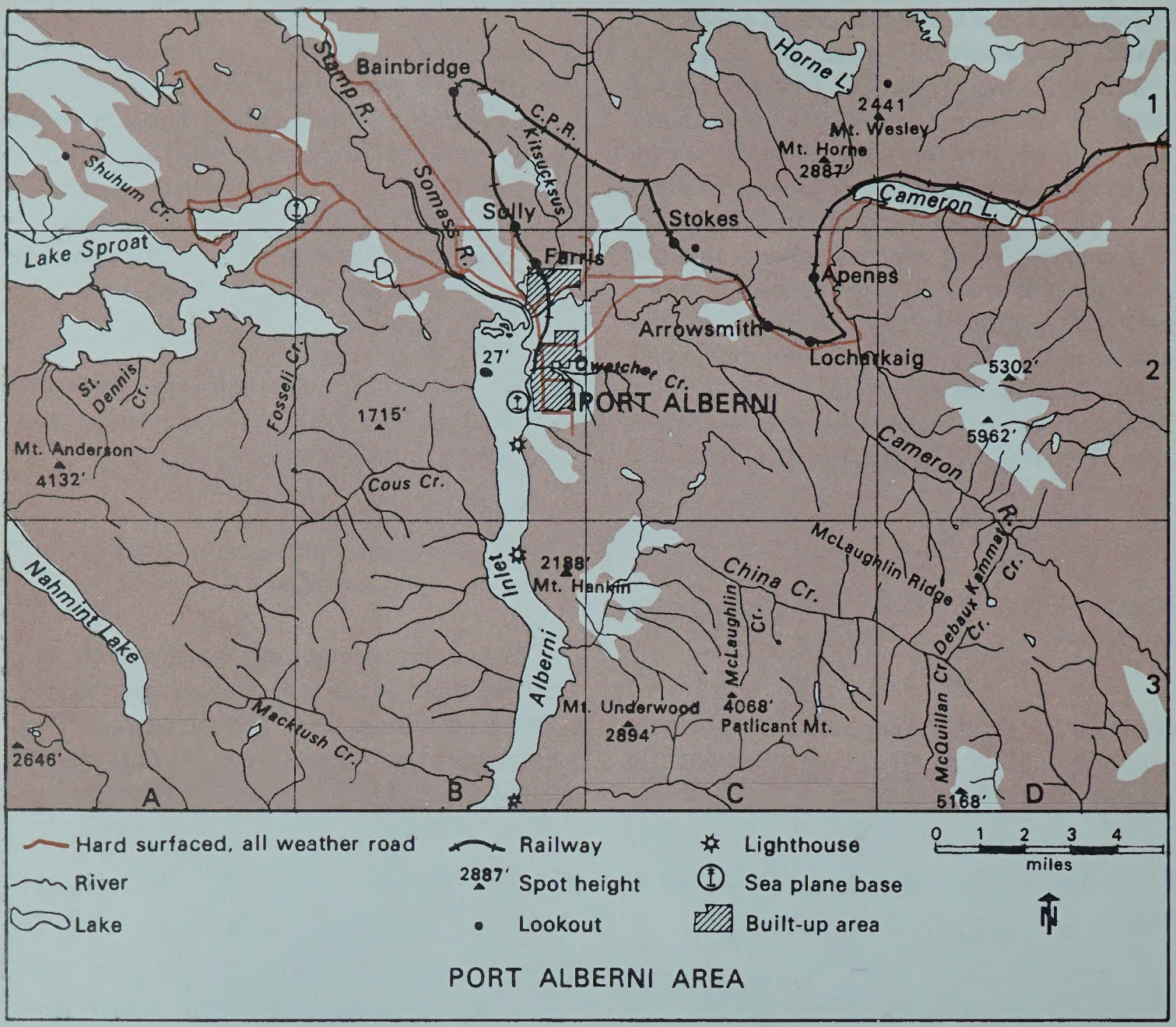


Figure 3

Figure 4 is a more detailed map of the Port Alberni neighbourhood.

Exercise

1.

From looking at Figure 4, how might you describe the pattern of streets in Port Alberni?

You could call this a "grid-iron" pattern; do you know what a grid-iron is? Notice the pipeline which ends in the Reservoir on the southeast of Port Alberni. Presumably this stores drinking water for the town. One of the interesting things about this map is the number of railway lines marked as *abandoned or under construction*. It seems most unlikely that they are under construction.

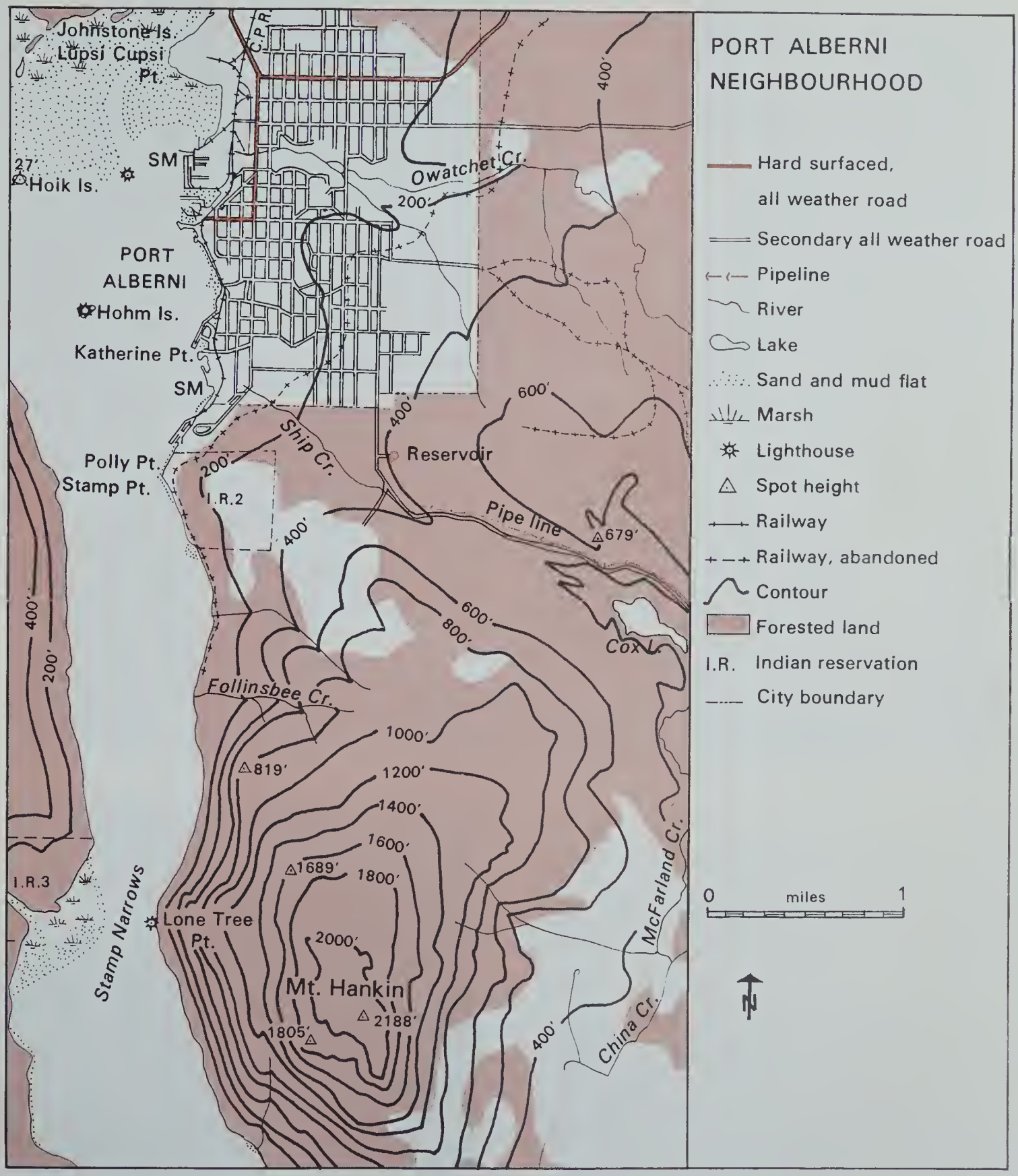

PORT ALBERNI
NEIGHBOURHOOD
Hard surfaced, all weather road
Secondary all weather road
Pipeline
River
Lake
Sand and mud flat
Marsh
Lighthouse
Spot height
Railway
Railway, abandoned
Contour
Forested land
I.R. Indian reservation
City boundary
0 miles 1
Johnstone Is.
Lupsi Cupsi Pt.
C.P.R.
27'
Hoik Is.
SM
Owatchet Cr.
PORT ALBERNI
Hohm Is.
Katherine Pt.
SM
Ship Cr.
Reservoir
Polly Pt.
Stamp Pt.
I.R.2
Pipe line
679'
Cox L.
Follinsbee Cr.
819'
1689'
I.R.3
Lone Tree Pt.
Stamp Narrows
Mt. Hankin
2188'
1805'
McFarland Cr.
China Cr.
400'
200'
600'
800'
1000'
1200'
1400'
1600'
1800'
2000'

Figure 4

Exercise

1.
Can you guess why they were built in the first place and why they have since been abandoned?

2.
Why do you think the CPR follows the shoreline so closely?

3.
What do the letters SM *stand for on this map? Turn this page upside down to find the answer.*

(Saw Mill)

4.
How many lighthouses can you identify on this map? Why do you think they would be placed just where they are?

5.
Would you imagine that Alberni Inlet is much used by shipping? Why?

6.
Would the captain of a ship think that the western flank of Mount Hankin was steep? How can you tell?

7.
Try to identify the Pulp Mill on this map. It stands in the angle formed by the Alberni road and the CPR railway, on Lupsi Cupsi Point.

Mr. Hartt looked at a booklet on Port Alberni which he had in his drawer at home. This gave the population of Alberni Valley which includes the city of Port Alberni as 19,000 in 1968. How does this compare with the population of your town?

Meeting the Hartt Family

Mr. Hartt came to meet us as we landed at the jetty, and we went directly to his home on 11th Avenue North. Here we met Mrs. Hartt, Janet and Brian, and of course Teddy, the brown retriever, and Tommy, the ginger tom cat where they had been sitting outside in the garden. Theirs is a charming home, much of it constructed by Mr. Hartt himself. Look at Figure 6.

Exercise

1.
What is the name of the paper Mr. Hartt is reading?

2.
What do you think Mrs. Hartt is holding on her knee?

3.
What are Janet and Brian doing? From this picture, could you guess how old these two are?

Figure 5

Figure 6

Mr. and Mrs. Hartt say that they have enjoyed living in Port Alberni. Certainly, they would rather live here than in a big city because they can find plenty to do both indoors and out. They spend many weekends boating and camping in the summer months, and during the winter, apart from ordinary entertainments, they attend adult education classes. Mrs. Hartt has taken classes in tailoring and dressmaking, pottery, home nursing and driftwood finishing. (Does that give you a clue as to what Mrs. Hartt is holding on her knee?) Mr. Hartt has taken courses in house wiring, how to invest money, new mathematics, Spanish, and now — marine piloting.

Mr. Hartt describes Port Alberni as well supplied with modern schools. Janet is attending a Junior High School. Brian is still in Elementary School. Mr. Hartt expects that Janet and Brian will be well prepared to go on from high school to college or university in Victoria or Vancouver. For both of them, this prospect is some way ahead yet, but the important thing is that there are opportunities available when they are ready.

Figure 7

Mr. and Mrs. Hartt can buy almost anything they need in Port Alberni itself. Mrs. Hartt says that she can choose among many clothing and department stores and supermarkets. "We do go to Vancouver or Victoria for an occasional change," she says, "but we can really do just as well here." Mr. Hartt too can easily buy the hardware, building or sports materials which he might want. He is certainly not likely to run out of plywood or equipment for his boat, — is he?, in a place like this.

Port Alberni is dependent on the forest products industry. If the company closed the lumber, plywood, pulp and paper mills here, the town would certainly become a kind of ghost town. Many men would be out of work; shops and stores would close for lack of customers; schools would close because parents would take their children with them away from the area. (Can you think of more things that would happen if the mills closed?) Happily, this is a most unlikely event, and in the meantime Port Alberni works and thrives. Mr. Hartt says that he

knows of many more towns across the country that would be much more truly called mill towels, because almost everything in those towns would be owned by the companies concerned.

Let's go into the kitchen (Figure 7) where Mrs. Hartt is preparing dinner. Meanwhile, Janet makes a note of some of the groceries which she and her mother must buy tomorrow morning.

Exercise

1.

Look carefully at the picture of Mrs. Hartt in her kitchen and write down the names of all the articles which you can see are made of paper or cardboard. (You should be able to list at least ten of these.)

You will notice that some of these — like waxed paper — have been specially treated in some way. These are not made in Port Alberni. The pulp and paper mill here, in addition to making some paper and cardboard, supplies other factories with materials they need to make their products.

2.

Can you think of yet more articles made of paper which are not shown in this picture?

3.

Now will you think for a moment what would happen if all the things made of paper in Canada suddenly disappeared? Would you be pleased if your writing paper suddenly "melted" from under your pencil or pen? Would you like all your clothes to be made of "disposable" paper so that you could throw them away when they were soiled? What would some of the consequences be if everyone took to wearing disposable paper clothes all the time? Suppose you asked Mrs. Hartt this question; what do you guess she might reply? Do you think we might ever reach this stage?

In the late summer and well into the fall, the Hartts can often sit outside comfortably. Here, near to the sea, the fall is generally warm. The Pacific coastland and the islands off the west coast of Canada tend to have cloudy skies, a good deal of rain, and warmish weather even in the winter. Mr. Hartt's home has no basement. He doesn't need to bother much about the intense cold winter which affects Canada east of the Rockies. Mr. Hartt came to the coast of British Columbia 18 years ago from Saskatchewan, so he does know how cold winter can be.

Rain and Snow, High Temperatures and Low

Class Project

How tall are your classmates? Suppose you measured each of them, added up all the figures you obtained by doing this and then divided that by the number of students you measured. What would you have found by this process? The average — which is often called the mean. *Would any one of your classmates be exactly average in height? It is most unlikely; the odd thing is that anyone who was exactly average would be quite* exceptional. *Of course, you don't have to take someone else's word for that statement; you could find out for yourself.*

Day by day in thousands of "stations" all over the world, men record the amount of rain or snow which fell in the previous twenty-four hours. They record the shade temperature and the humidity. They record maximum temperatures and minimum temperatures, and the force of the wind and its direction. They count the number of hours of sunshine and so on. Each month they work out totals and averages for each of these various items. At the end of each year, they calculate totals for the year. They — and those who came before them and those who follow after them — do this for thirty years continuously, always producing averages and averages of totals, until they can safely say "These are the features of the *climate* of this or that station."

For Port Alberni these records extend over more than thirty years, and so we can say with certainty that they are *reliable*. They are not, that is, the records for four exceptionally dry years or five exceptionally cold years or seven exceptionally snowy years. Over thirty years, the very dry and the very wet will have cancelled each other out. Likewise, the very hot and the very cold Januarys or Julys will have cancelled each other out. Figure 8 shows some of the figures for Port Alberni. Try to answer these questions by looking carefully at them.

Temperature

Exercise

1.

What is the average temperature in January *in Port Alberni?*——— *in* July*?*———

2.

What is the average temperature in January *in your town?*——— *in* July*?*———

3.

Would you think Port Alberni is a cold place in January*?*——— *in* July*?*———
(Remember that the actual temperature is very rarely average. Mr. Hartt described winters in Port Alberni as mild. Last year, he said, roses around the house started to bloom in late December, and on the day before Christmas, one of his neighbours brought him a cluster of raspberries which had just ripened out of doors!)

4.

What is the lowest temperature in January *recorded in Port Alberni?* ——— *in* July*?* ———

5.

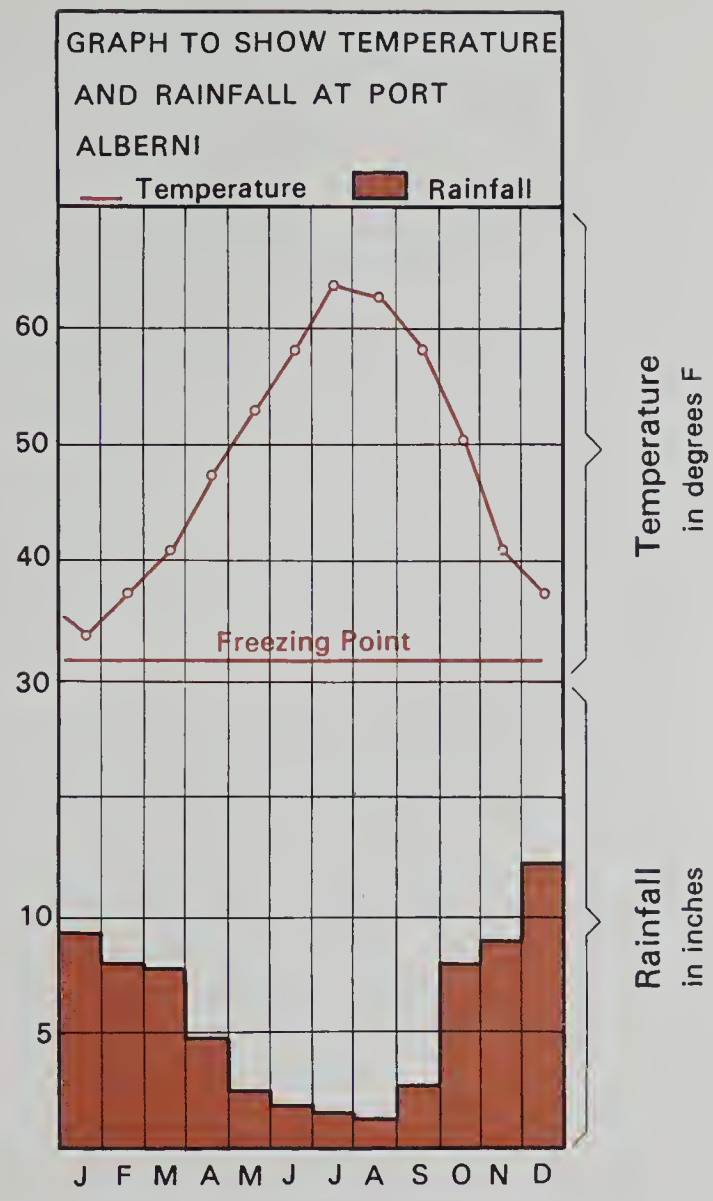
What is the highest temperature in January *recorded in Port Alberni?* ——— *in* July*?* ———
(The difference between the highest and lowest in any set of figures is called *the range.)*

6.

What is the range of Mean Daily Temperatures in Port Alberni? — the difference between January *and* July *Mean Daily Temperatures? Compared with the figures for your town, is this a big range or not? How do you account for it?*

Precipitation

You would have to melt about one foot of snow to produce as much water as one inch of rain. Look at the January snowfall in Port



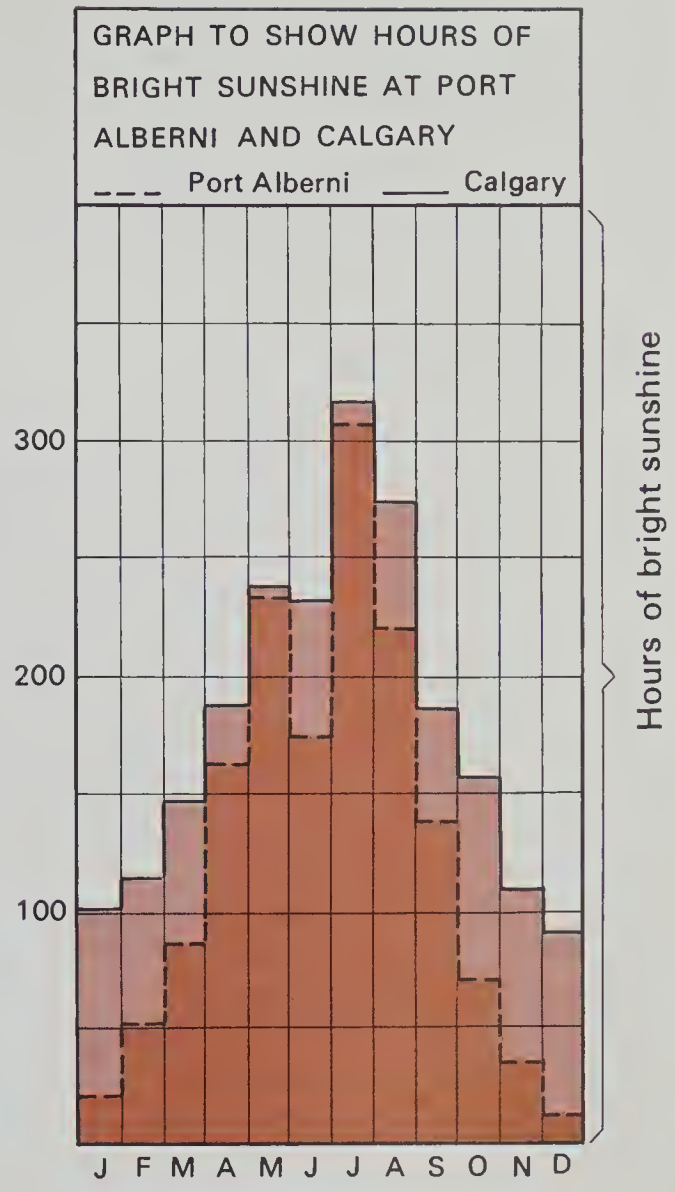


Figure 8

Alberni. This snowfall, converted to inches of rain, may be added to the rainfall to give the amounts shown here as Mean Total Precipitation. Try now to answer the following questions:

Exercise

1.
Which is the wettest month in Port Alberni?
——— *Amount of precipitation?* ———

2.
Which is the wettest month in your town?
——— *Amount of precipitation?* ———

3.
Which is the driest month in Port Alberni?
——— *Amount of precipitation?* ———

4.
Which is the driest month in your town?
——— *Amount of precipitation?* ———

5.
What is the average total annual precipitation in Port Alberni? ———

6.
Does this seem to you to be wet or dry compared with your town? ———

Other Features

Look at the number of days when measurable rain falls in Port Alberni. You will see that measurable rain will fall somewhat *more often than one day in three*. If you now look at the graph to show the number of *Hours of Bright Sunshine* in Figure 8 you will see that Port Alberni has only twenty-one hours in January or, if you like, less than one hour per day. Calgary has rather more than three hours per day in January. In July Port Alberni has 300 hours of Bright Sunshine or almost ten hours per day! Whereas Port Alberni has 1522 hours of Bright Sunshine in the year, Calgary has 2166 hours. How might you explain this difference?

If we put all these various pieces of information together we have a description of the climate of Port Alberni. It has what we might call an *equable* climate which is never very cold and never very hot. The annual range of temperature is low. The summer is drier than the other seasons, but no month is without rain. If there is less bright sunshine in Port Alberni than in many other places, then Port Alberni must generally have cloudier skies.

Port Alberni stands in well-watered, mountainous country. Trees and water are the "raw materials" of the pulp mill. Besides trees and water, the mill uses a great deal of power. Falls on the rivers or sluices in the dams are harnessed to produce power and to produce it fairly cheaply. Neither the sea nor the rivers here freeze over. Ships, barges, and floating rafts of logs can move freely throughout the year. Perhaps now you see some of the reasons why the company chose to build a great pulp and paper mill here in Port Alberni.

II First Impressions

A First Look at the Mill

The morning after our arrival in Port Alberni happened to be a Saturday and Mr. Hartt drove us along the waterfront talking enthusiastically about the growth of the town which has been his home for 13 years. He had permission to take us through the gates and onto the site of the pulp and paper mill pictured in Figure 9. We went out along the jetty, and from the sliding doors of the great sheds at the seaward end, we looked back towards the main buildings. We were most fortunate to have seen the mill first from this vantage point. Mr. Hartt was able to point out to us its most important features as we looked carefully at them one after another.

Exercise

Match the letters on Figure 9 with the words in capital letters in the statements below, and as you do so, write the letters on a strip of paper marked off like the column on the right of the exercise. (We have written in the first letter to show you what to do. It is B because LOGS FLOATING are marked B on the photograph.)
If you read these statements one after another without long pauses between, you will have a brief account of the plan of the pulp and paper mill.

1. LOGS FLOATING *in the water (called the "pond") are . . B*

2. *carried on a* JACK LADDER, *a kind of conveyor belt . . .*

3. *up into a* MILL *where they are debarked and cut into lengths, some of which are made into chips.*

4. *From there, the chips are carried along pipes to big* HOPPERS, *or blown onto a great* PILE.

5. *As they are wanted, the chips go by conveyor belt from hopper or pile to huge* DIGESTERS *where they are "cooked" in chemicals and made into a thin brown "porridge-like" substance.*

6. *From the mill where they are debarked, some logs are floated intact in a long* FLUME *round the mill and into a grinding shed where they are ground into a thin white "porridge-like" substance.*

7. *The thin white "porridge-like" substances, cooked or ground, are spread as a thin layer onto moving belts of wire mesh and carried down the entire length of the* MAIN MILL *over rollers and through dryers.*

Figure 9

8. *At the end of this process the "porridge-like" substance has become roll upon roll of paper ready to be sent away by* TRUCK, *by* RAILWAY VAN, *or by* DEEPSEA VESSELS *or* BARGES. *This paper is sent to all points of Canada, to the United States and to other countries.*

Note: The correct order of answers for this exercise appear at the bottom of this page.

Turn the page upside down, and you can read the answers in their correct order.

Exercise

By looking carefully at the photograph, can you make a plan of the mill? If you can, label it with all the terms used above.

B D A G C H F E I

The Logs Arrive

Most of the paper used in the world today is made from soft woods like spruce, hemlock, pine and fir. You can therefore see immediately — can't you? — why northwestern Canada and the Port Alberni region in particular, would be a most suitable site for a paper mill. If you can't see this, then look again at the maps and graphs on pages 4, 11 and Figure 9.

Exercise

1.

What evidence do the maps and graphs mentioned above give you that Port Alberni is a most suitable site for a mill?

2.

Look at an atlas and find out where Canada's and the world's softwood forests are.

3.

Name some types of hardwood trees. Where do hard woods grow? What are they used for?

Figure 10

The forests producing the trees may be many miles from Port Alberni. How then do logs reach the mill? First they are trimmed; the branches are cut off, and the trunks are cut into lengths so that they can be dragged to some point where they can be loaded onto a truck. They usually go by forest road to some point on the Alberni Canal or the coast. Here they are collected and chained into giant rafts to be towed to the Port Alberni mill. Sometimes without being made into rafts, they are loaded onto the decks of great barges and so carried to where they are needed.

Look at Figure 10. A barge has arrived with a load of logs. How are the men going to "unload" these logs?

Figure 11

Exercise

1.

How would you unload the logs?

2.

What do the men working the small tugs called dozer boats *have to do once the logs are in the water?*

3.

Do rafts of logs go immediately to the mill? If not, where might they be anchored until they are wanted? (Figure 1 should give you the answer to this question.)

4.

What area, in square yards, might be covered by logs in this picture?

5.

When eventually the tugs worry the rafts into the "pond" beside the mill, do the logs seem to make a pattern in the water or are they scattered to lie in all directions?

6.

Where will they be going from the pond? (Look back to Figure 9.)

Figure 12

Would you like to work in one of the "dozer boats" shown in Figure 11? What do you think might be some of the pleasant features and some of the less pleasant features of this job?

The men who work in the dozer boats have not only to arrange the logs as necessary, but have also to sort them into species, for example putting all the spruce logs together.

Exercise

1.
Can you offer one reason why they might sort the logs so that all the logs of one species are together?

2.
Would you think that the kind of wood used at any time might affect the quality of the paper made in the mill?

The logs have arrived in the pond. They must now go up into the mill. At the final stage, a man using a spiked pole, called a *pike pole*, guides each log to the foot of the "jack-ladder". At this point, lugs set in an endless chain, grip the logs so that they are carried up a smooth metal channel as shown in Figure 12. You see the foot of the jack-ladder in Figure 13.

Exercise

1.
Why do you think Mr. Hartt's friend shown in this picture, is wearing a life belt?
Notice the catwalk on the right hand side of the picture. There is a similar one on the left.

2.
Why do you think the catwalks are needed?

3.
Would the logs ever jam as they go up the ladder?

Notice the wood splinters and bits of bark floating in the water at the foot of the ladder.

Inside the mill, the bark is stripped from the logs. Have you ever peeled bark off a log? If you have, you will know that if you can find a crack into which you can push something sharp — like a screw driver or a crow bar — you peel it off fairly easily. In this mill the "sharp instrument" is replaced by jets of water under great pressure — 1200 pounds per square inch — as shown in Figure 14. These pierce any crack or hollow in the bark of logs passing under them and peel it off. This is an ear-splitting as well as log-splitting process which leaves the logs clean but much splintered as you can see in Figure 15. In Figure 16, Mr. Hartt is watching the cleaned logs being turned over and rolled by mechanical arms towards a bank of *slasher saws*.

After they have been peeled, mechanical arms roll the logs toward the "slasher saws". These are circular saws projecting through a sloping metal surface about 40 feet each way. Up this sloping surface run endless chains armed with strong metal lugs 8-10 inches high. The saws are staggered across the metal surface so that logs carried up the slope by the lugs in the chains meet first one saw and then another. Even so, the noise is deafening as three or four saws are always at work together since the logs follow one another rapidly. You can

Figure 13

Figure 14

see from Figure 15 that the whole sloping metal surface is encased in a structure of steel and heavy wire mesh.

Exercise

Can you guess why this should be so?

Now peeled, and cut into four foot lengths, the logs are sent some one way, some another. One line goes immediately to the chipping machine. Each log falls into the machine almost end on, and its own weight brings it against a series of whirling sharpened blades. These blades, turning downwards toward the end of the log, almost like sharpening a pencil with a knife, pull it down and slash it up into chips about as big as the top of a spool of thread. When a log is going through — which happens every ten seconds or so — the metal deck on which you can stand just above the chipper, shakes and rattles and you certainly can't hear yourself speak.

Many of the logs which have been peeled and cut into lengths do not go into the chipping machines. They tumble into a water-filled flume to float and slide round the mill

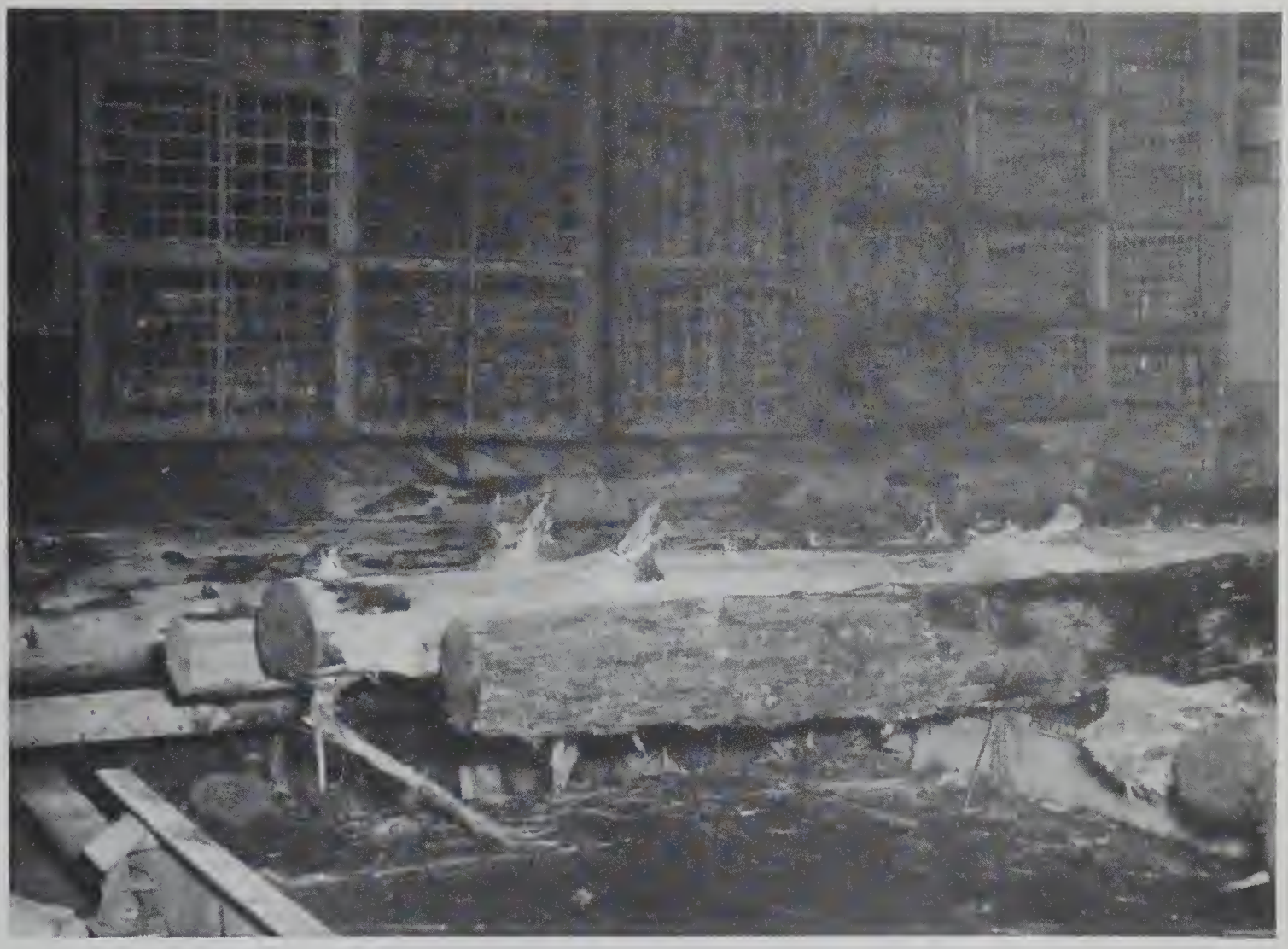


Figure 15

("H" on Figure 9, Page 14) to the bank of grinding machines. Here they are turned into the white "porridge-like" substance called *mechanical* pulp.

Exercise

1.

Why do you think the white "porridge-like" substance is distinguished as mechanical *pulp?*

2.

What other kind of pulp is there? (Item 5 on Page 13 will give you a clue here.)

In a mill as big as this one at Port Alberni, hundreds of thousands of tons of bark are stripped off the logs going through the mill each year. One question which the industrialist must always ask himself is, How can we dispose of our waste products? Fortunately, when he asks this question about bark, he has an obvious answer.

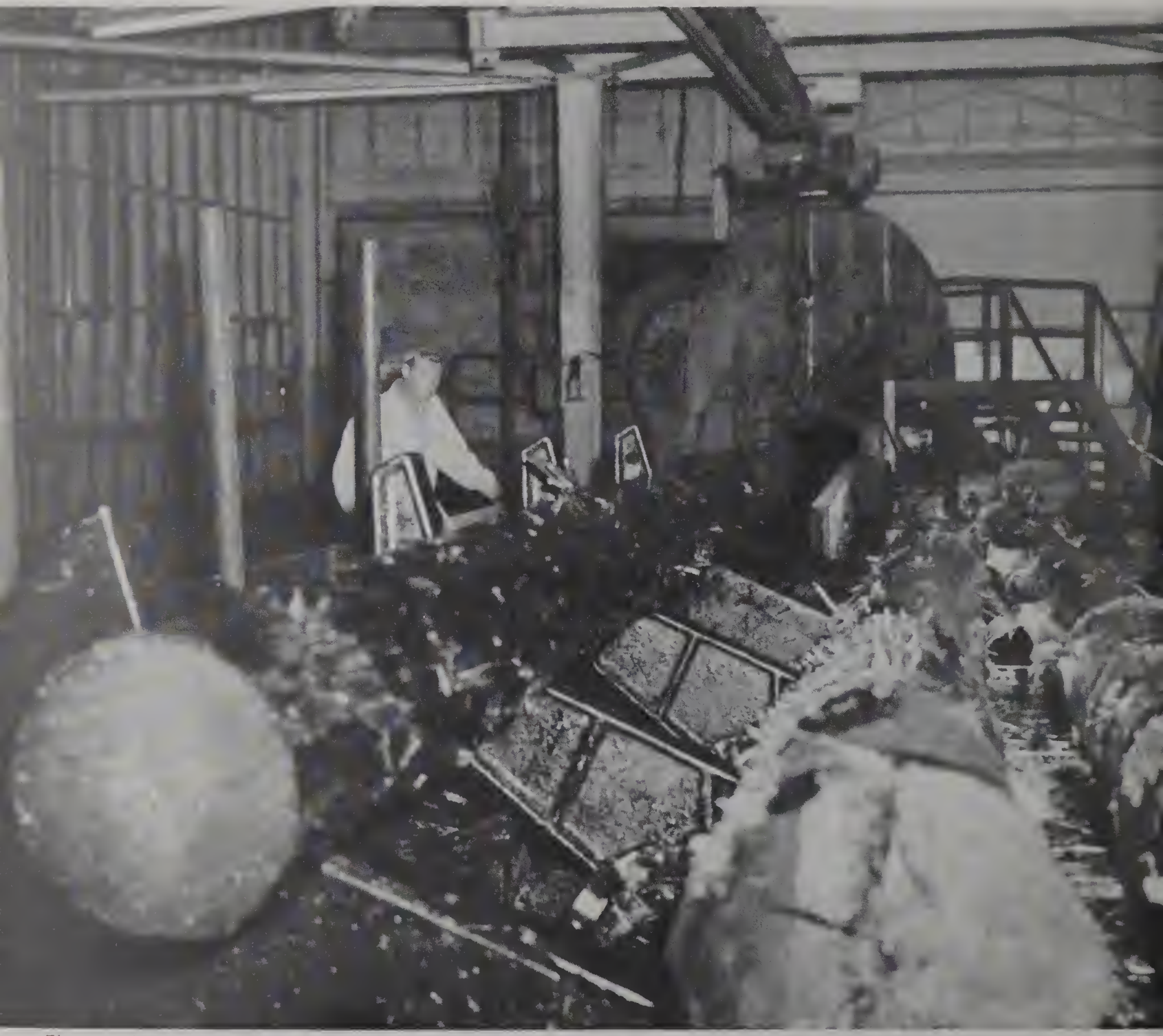


Figure 16

Exercise

If you were in his place, what would you *do with it?*

Would you throw it back into the Inlet and hope that the tide would carry it away? That wouldn't be either a pleasant or a profitable way of dealing with it, would it? If the industrialist — or you in his place — were

wise, you would ask not only, How can we dispose of it? but also, Could we dispose of it perhaps by *using* it in some way? If he could use it, then he would reduce the cost of running the mill. So now, How would you *use* it? is a better question to ask.

In Figure 17 you see a pile of bark. Suppose that the bulldozer is ten feet high, then how high is the pile? A conveyor belt carries the bark in a continuous stream into a *boiler house*, and there it is burnt to raise steam. (I'm sure you guessed how the bark would be used, didn't you?) The steam is used to generate some of the electricity used in the factory. It is also used in the process of "cooking" the wood chips to make chemical pulp.

On the right of Figure 17 you see concrete silos used for storing wood chips.

Interlude

After we had seen, heard and smelled logs being peeled, sawn and chipped, it was good

Figure 17

to walk in sunshine and comparative quiet across to the great piles of bark and wood chips near to the main buildings of the mill. On our way, we read the notice shown in Figure 18.

Exercise

1.

What does it say nine times?

2.

How many languages can you recognize?

3.

Can you identify the second and eighth of those in the smaller characters or letters?

4.

Why do you suppose the owners of the mills considered it necessary to put up a notice of this kind in so many languages?

5.

Why might people from other countries visit this mill?

Figure 18

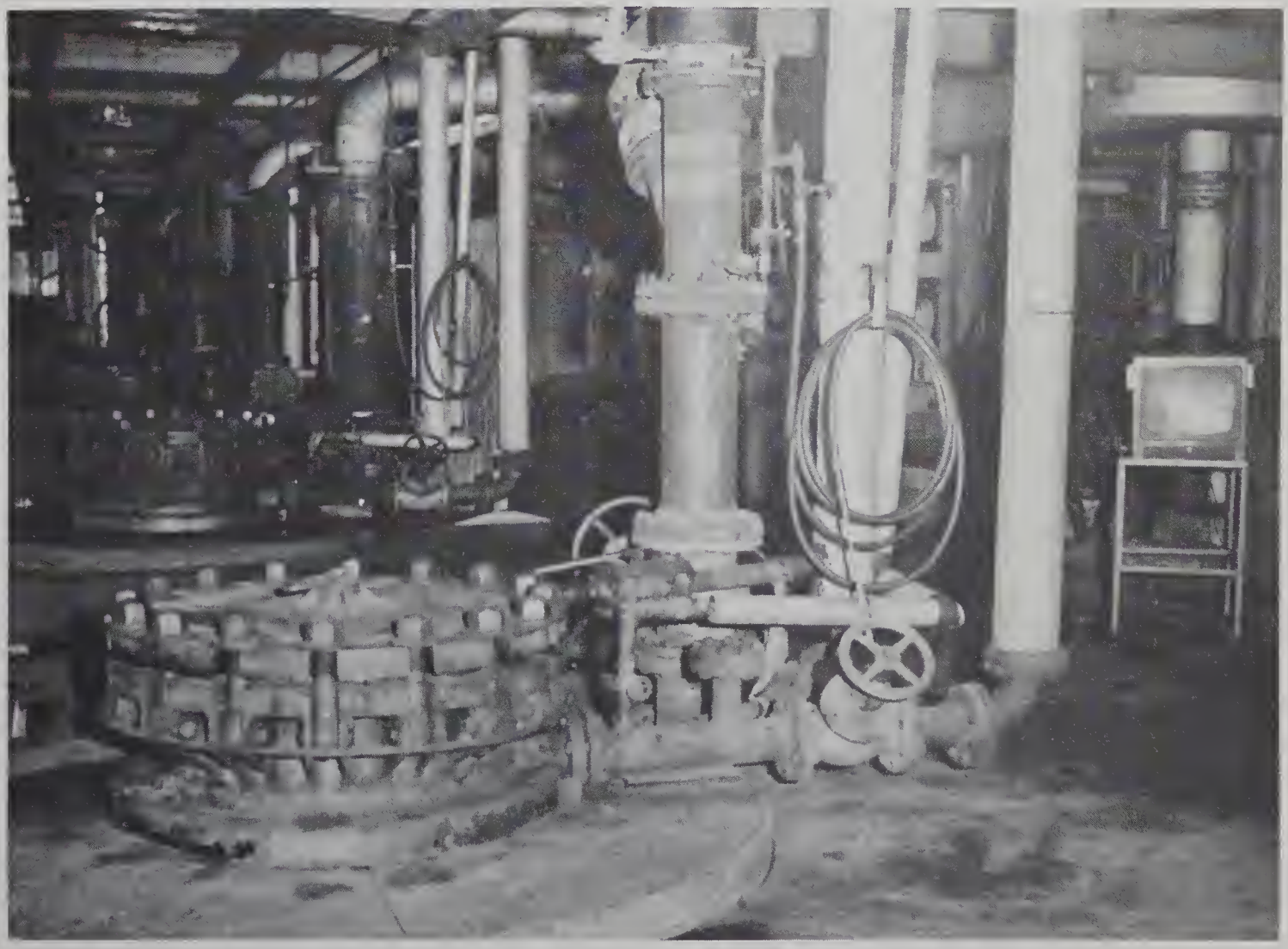
III The Next Step—Pulp

Making Pulp

Cooking

According to the chemists who work in the mill, wood consists mainly of cellulose fibres, lignin (a glue-like substance), and two other substances which you know about already.

Figure 19



Exercise

1.
What oozes from a pine if you make a hole in it?

2.
What do you get by tapping a maple?

The fibres in which we are particularly interested are only a few millimeters in length. One way of freeing these fibres from the lignin, resin and sugar is to dissolve the last three by *cooking* wood chips with *cooking liquors*.

Before they are "cooked", chips from the storage pile or hoppers are screened to remove pieces of knot and other impurities which might not be digested in the cooking. The digesters, as the cookers are called, are about 50 feet tall and 12 feet in diameter.

Exercise

How high is the room in which you are now working? How many times higher is a digester?

They work on much the same principle as kitchen pressure cookers. In Figure 19, we see the lids of a row of these *pressure cookers*. Notice the various pipes which carry the dangerous caustic "cooking liquors". (Look up the word "caustic" in your dictionary.) Notice too, the heavy bolts which hold down the lids of digesters. (How is the lid held on your pressure cooker at home?) Inside the digesters the liquor is heated by steam to a high temperature and the chips are cooked for some hours. The time taken for the chips to cook depends on the kind of wood in use and on which of various combinations of chemicals is to be used. When the lignin, resin and sugar are dissolved, almost pure cellulose remains.

At the end of the process, the digester contains a wet pulpy mass. This is "blown" from the digester to tanks where it is washed. The valuable spent chemicals are washed out of it at the same time and are recovered to be used again. This is one more example of the way in which the industrialist avoids having to dispose of apparently waste materials and, at the same time, reduces the cost of running his mill. What do you think might happen if caustic liquor, washed out of the pulp in the digesters, flowed untreated into Alberni Inlet?

Exercise

1.
Do you recognize the little white screen on the extreme right of Figure 19?

2.
Why do you think it is there?

3.
If he had a number of these could one man half way down this gallery watch a number of digesters being loaded with chips at the same time?

This kind of digester has to be filled and emptied every three hours. These digesters are now old-fashioned and this mill already has a "continuous digester" in use. Chips pass into the top of this digester in a continuous stream, and correspondingly, cellulose is drawn off continuously at the bottom. Waste of time and effort in opening, charging, opening and emptying the digester is avoided in the new continuous process.

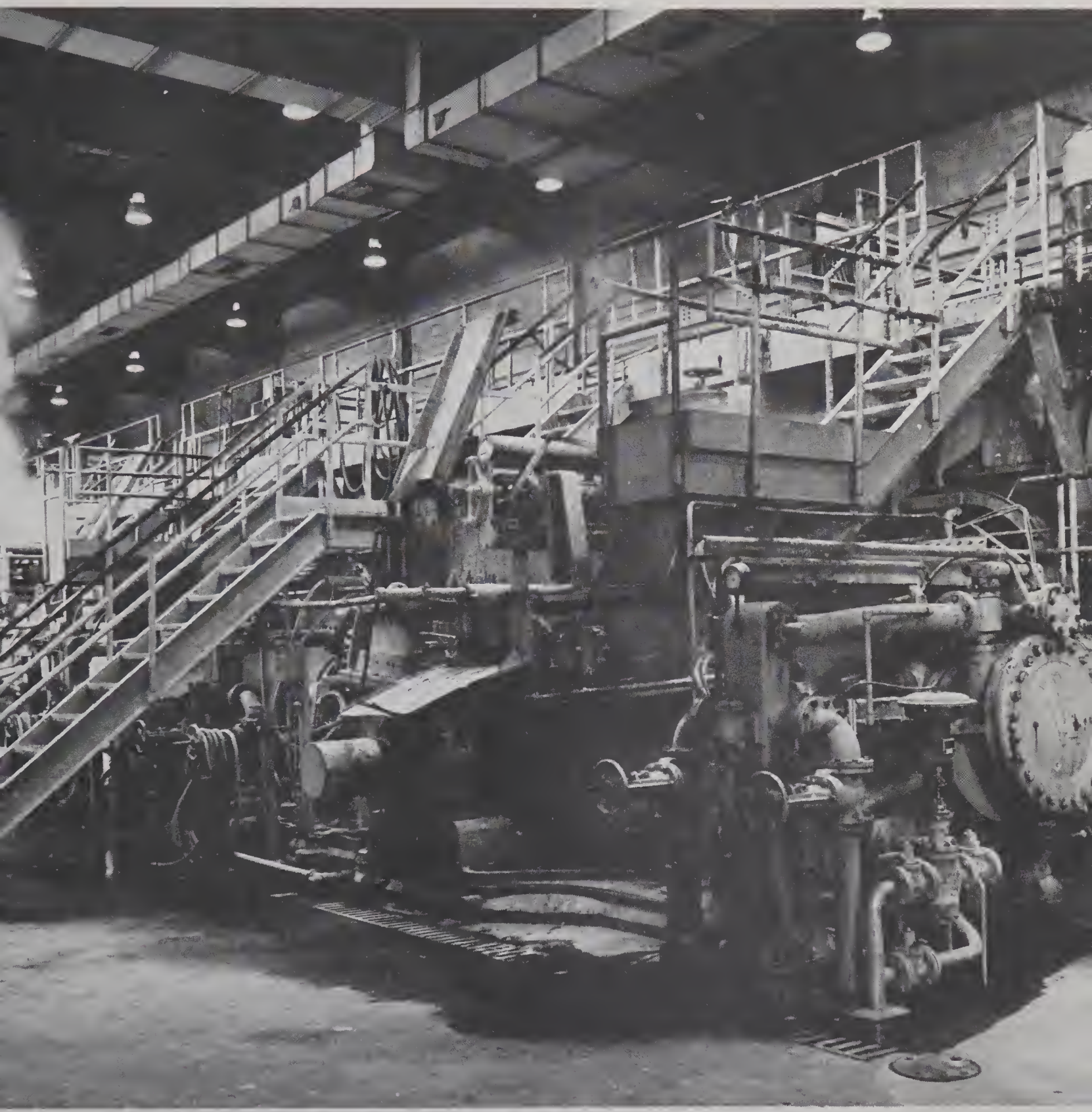


Figure 20

Exercise

1.
Do you think that this might be a more efficient digester?

2.
Would you expect it to be a cheaper one to run than the older type of digester? Why — or why not?

Before we continue our study of pulp and paper, it would be a good idea to stop for a moment at this point to examine the processes we have seen so far.

Exercise

1.
How do logs reach the mill?

2.
At what stage is the bark chipped off?

3.
Describe slasher saws. What do they do?

4.
Why are wood chips "cooked"? How is this done?

Grinding

Earlier we said that many of the logs which have been peeled and cut into lengths do not go into the chipping machines. They tumble into a water-filled flume to float and slide round the mill to the bank of grinding machines. Here they are turned directly into the white porridge-like substance called *mechanical pulp.* It is time now that we visited this part of the mill.

Logs pass from the flume onto a conveyor belt which runs the length of the mill, and about 10 feet above the level of the floor. Automatically, one by one, the logs are made to fall into the grinding machines shown in Figure 19. Eleven of these machines stand in a grinding, screaming row in what seems to be a dimly lit shed. Men walk along beside the conveyor belt ready to prevent logs from getting jammed against one another. Meanwhile, the logs fall against the grindstones, which are like great barrels. Look at the one shown in Figure 20. As they are forced against the revolving stone faces of the grinders, the logs are quickly reduced to fibres.

The mass of mushy fibres is swilled by vast quantities of water onto screens where heavy knotted particles and other unwanted materials are removed. The thin mush (known as *slurry*) is then mixed with a smaller amount of chemical pulp. Before ground wood and chemical pulp can be turned into paper they must be bleached. For this purpose chlorine and other chemicals are used.

Class Project

1.
Look at the grindstone shown in Figure 21. Suppose that the workman is about six feet tall. Can you estimate

(i) the diameter of the grindstone, and
(ii) how long it is?

Because the grindstones must be replaced quite frequently, they must be of a standard

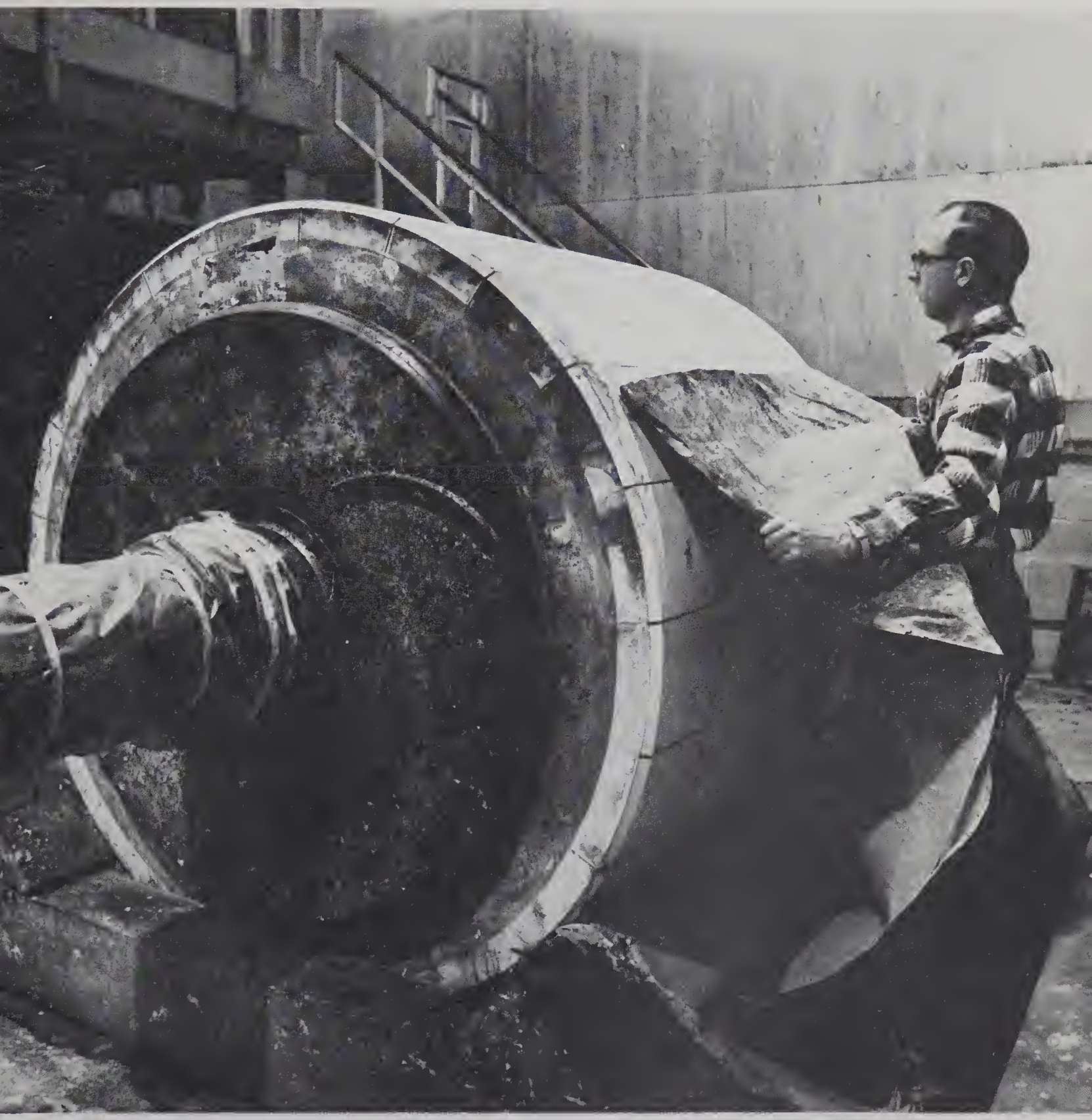


Figure 21

size. The actual sizes are shown at the foot of page 32. Check your own answers against these.

2.

If your mother uses laundry bleach, try the following experiment. Write your name in ordinary ink on a narrow slip of lined paper. Ask your mother to pour a little bleach into a saucer. Put the slip of paper into the bleach. What happens to your name and to the lines on the paper? Do you smell anything as you lean over the saucer? Does the "smell" affect your throat or your eyes? What causes *this "smell"? Used as a heavy, greenish gas, the substance which gives its characteristic smell to bleach was used as a* poison gas *in the First World War.*

3.

Why must men working in this mill learn to obey safety instructions most carefully? Could you think of some jobs which might be more dangerous than others in this mill?

4.

Who makes regulations governing safety in factories? Who sees that they are carried out? If the manager of a mill like this failed to see that safety regulations were observed, what might happen to him?

Family Interlude

We thought that it would be pleasant at this point to take a short holiday with the Hartt family. Here they all are again in Figure 22 — Mr. and Mrs. Hartt, Janet, Brian, and of course (with his back to us) Teddy.

A committee of the Port Alberni Council arranges recreation in the town, and Mr. and Mrs. Hartt are happy that this is so, both for themselves and for Janet and Brian. The town has an "arena complex" which consists of a six-sheet curling rink with a lounge, and a hockey rink also with a lounge. Mr. Hartt knows the arena complex well as he is second Vice-President of the Curling Club this year. Meanwhile, Janet and Brian belong to the Mount Arrowsmith Figure Skating Club. (See squares 2C and 2D of Figure 3, page 4.) Occasionally Mr. and Mrs. Hartt swim in the indoor pool at the Echo Centre. Janet and Brian go swimming there too, but much more frequently than their mother and father. In addition to a swimming pool, the Echo Centre has a senior citizens' lounge, a recreation room, a carpet bowling rink and a fine banquet room.

In the summer, Mr. and Mrs. Hartt, Janet, Brian, and of course Teddy, spend many of their weekends camping and boating. Their camping equipment consists of a canvas tent, four folding cots with sleeping bags, a two-burner stove, a lantern, a grocery box, and a food cooler box. All this fits into the trunk of the car or into the boat which, as you see from Figure 23, travels behind the car on a pale blue trailer.

When the Hartts drive to the coast, they take with them equipment for picking and opening clams and oysters. The east coast of Vancouver Island shelves gently into the Strait of Georgia (See Figure 2, page 2), and consequently, in some places more than half a mile of sand is uncovered at low tide. In the summer, this is firm and warm, and

Figure 22

the water which floods slowly back across it when the tide turns is warm too and delightful to lie in or to swim in. The west coast also has good sandy beaches, but here the waves tumbling in from the Pacific can be dangerous even for strong swimmers.

As you might expect, for people who live in a countryside like this, fishing is a favourite sport. In the spring, 2 and 3 year old Cohoe salmon, mostly "bluebacks", crowd down the Strait of Georgia, and Mr. Hartt says that those which the fishermen catch will usually weigh between 4 and 9 pounds. "Bluebacks" are so called because of the blueish sheen of their backs when they are young and in the early stages of their spawning run. As they struggle to reach their spawning grounds, against fast-flowing water and rapids, sometimes for hundreds of miles, they use much energy. Then their blue colour fades and is replaced by a reddish tinge. The fishing laws of British Columbia are designed to ensure that some of the fish win through to their spawning grounds where they lay and fertilize their eggs. Unhappily, not long after they have done this both the old female and the male fish die, but a large number of the young fish which hatch out of the eggs are able to make their way down the rivers to the ocean. There they in turn grow to maturity. Later some of these come back to spawn and milt in the upper reaches of the rivers where they themselves were hatched. If this were not so, then the Cohoe salmon would die out.

The fishermen return to Alberni Inlet in mid-August, for it is then that the Tyee salmon come up from the Pacific to spawn in the fresh water of the rivers. At this time, a number of clubs arrange fishing Derbys and give prizes to those who catch the biggest fish. The Tyee are mature salmon and almost every day some lucky or particularly skillful fisherman (or fisherwoman) lands a 40 or 50 pounder. According to a booklet issued by the Alberni Valley Tyee Club last year, a fisherwoman caught the biggest fish of the season; it weighed 57 lbs. 7 oz. Mr. and Mrs. Hartt and family fish in the Inlet, but they also visit the larger lakes in the area. These they reach by good roads, and beside the roads are ramps for launching boats.

In Figure 23 you can see Mr. Hartt launching the little outboard boat. How do we know that this is an "outboard" boat? Mrs. Hartt fends off, and Janet holds onto the headrope to prevent the boat from drifting away from the shore if Mr. Hartt should push too hard or if the wind should catch it. Meanwhile, Brian holds the fishing rods.

It looks as though the Hartt family is very interested in water, solid or liquid, doesn't it? One of the reasons for this may strike you if you look again at the map, Figure 3 on page 4. This is an area of lakes and streams as well as of forests. Indeed, if an abundance of water did not exist here among the forested hills, Port Alberni could not be what it is — an important centre for the manufacture of paper. The city pipeline carries 38,000 U.S. gallons per minute, and each day the mill uses some 55,000,000 gallons of water!

The grindstones are 67 inches in diameter and 45 inches long.

Class Project

1.

How much water does your town use each day?

2.

Before you turn to the next unit, look up the word "paper" in a big dictionary which tells you how words originated. What was first used to make paper and where was it first made? Do you remember the Bible story which tells us where Moses was found by the Pharaoh's daughter? That reminds us — have you ever looked up the word "bible" in the dictionary? Can you discover other words which start with "bibl"? What do they refer to?

3.

Make your own paper. Take two or three kleenex tissues and shred them up. Soak them in a saucerful of warm water and mash them up with a wooden spoon. Then lay the material out thinly on a piece of cloth stretched like a bed between two boards. The cloth should not rest on any other surface, but should be supported between the boards so as to allow the water to drain away freely. Look at the pulp again in a few hours when it has dried.

Figure 23

IV From Pulp to Paper

Making Paper

Different kinds of paper contain different proportions of chemical pulp and mechanical pulp. Newsprint, used for your newspaper, contains about 80 percent of mechanical pulp. Finer and stronger papers like that used for this book are made from chemical pulp.

No matter what proportions of chemical and mechanical pulp they contain, papers of all kinds are made in much the same way. First, the pulp is fed into what is called a *beater* tank. Beating the pulp causes very fine hair-like fibres to stand away from the thicker cores of the main fibres. We shall see in a moment the purpose of doing this. Also in the "beater tank" small quantities of starch, mixed with the water, may be added to the pulp — though none is added to the pulp which will become newsprint. Starch helps to stiffen and smooth paper much as it helps to stiffen and smooth a collar.*

When wood pulp is wet, the fibres do not stick together. Drain water from the pulp and the fibres *do* begin to stick together. This happens partly because the gluey lignin still left between them begins to set, and partly because the fine hair-like fibres raised in the "beater" tank begin to tangle with one another. While the fibres were wet, they were like fronds of seaweed in a tidal pool, floating and sliding over one another. So, paper-making machines take the wet "porridge-like" slurry (Figure 24) from the beater tanks and spread it thinly onto an endless screen which has many little holes in it. This screen is called a *Fourdrinier* because brothers of that name invented it.

The sheet of pulp travels on, supported underneath by a belt of finely woven felt. In this fashion, it passes between many pairs of rollers which gently squeeze water out of it. The pressure of the rollers also causes the wood fibres to pack more firmly together and consequently, though the sheet of pulp becomes progressively thinner, it also becomes progressively stronger. This thin sheet, now quite dry, is carried through a series of rollers called the *calendar stack* which "iron" it and give it a smooth surface.

Figure 25 shows the great newsprint machine in the Port Alberni mill.

** In some mills which make finer quality papers, clay may also be added in the beater tank. The clay, like that used for making porcelain, fills in spaces between the wood fibres and so again helps to make a finer, smoother paper. At this stage too, in the beater tank, dyes may be added where coloured papers are wanted.*

Figure 24

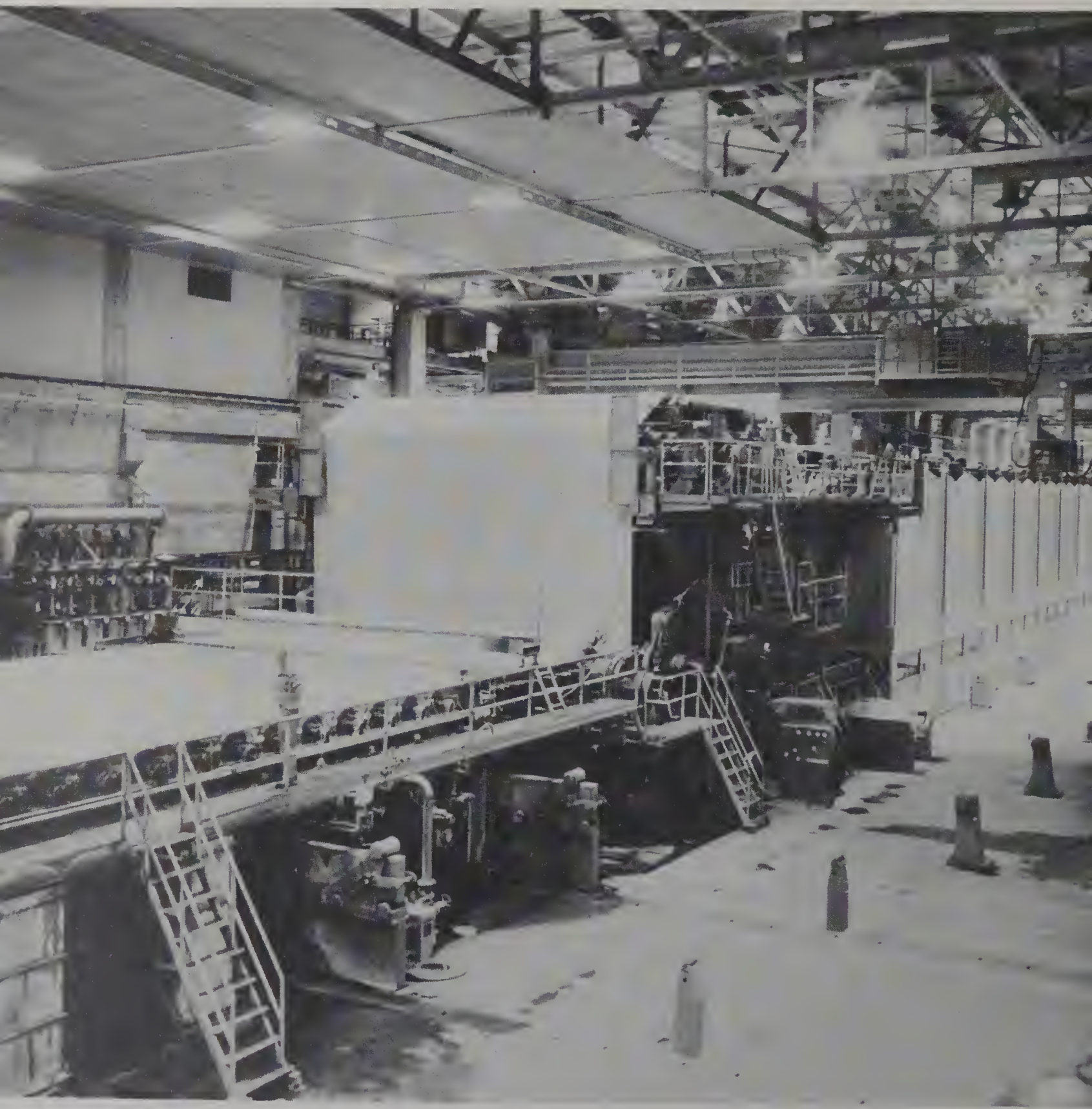


Figure 25

Exercise

See if you can answer these questions by studying the picture.

1.

About how wide is the sheet of pulp lying flat on the rollers in the foreground of the picture? (You can compare it to the size of the man.)

2.

About how long is this machine? Compare it with the length of a football field.

Figure 26

3.

The section in the foreground of the photo is called the "wet end" of the machine. Can you think why?

4.

From about the centre of the picture running away to the left-hand margin is what appears to be a wall of sheet metal. Can you think what this structure might be? Would you have expected to see much more steam and water about than appears in this picture?

5.

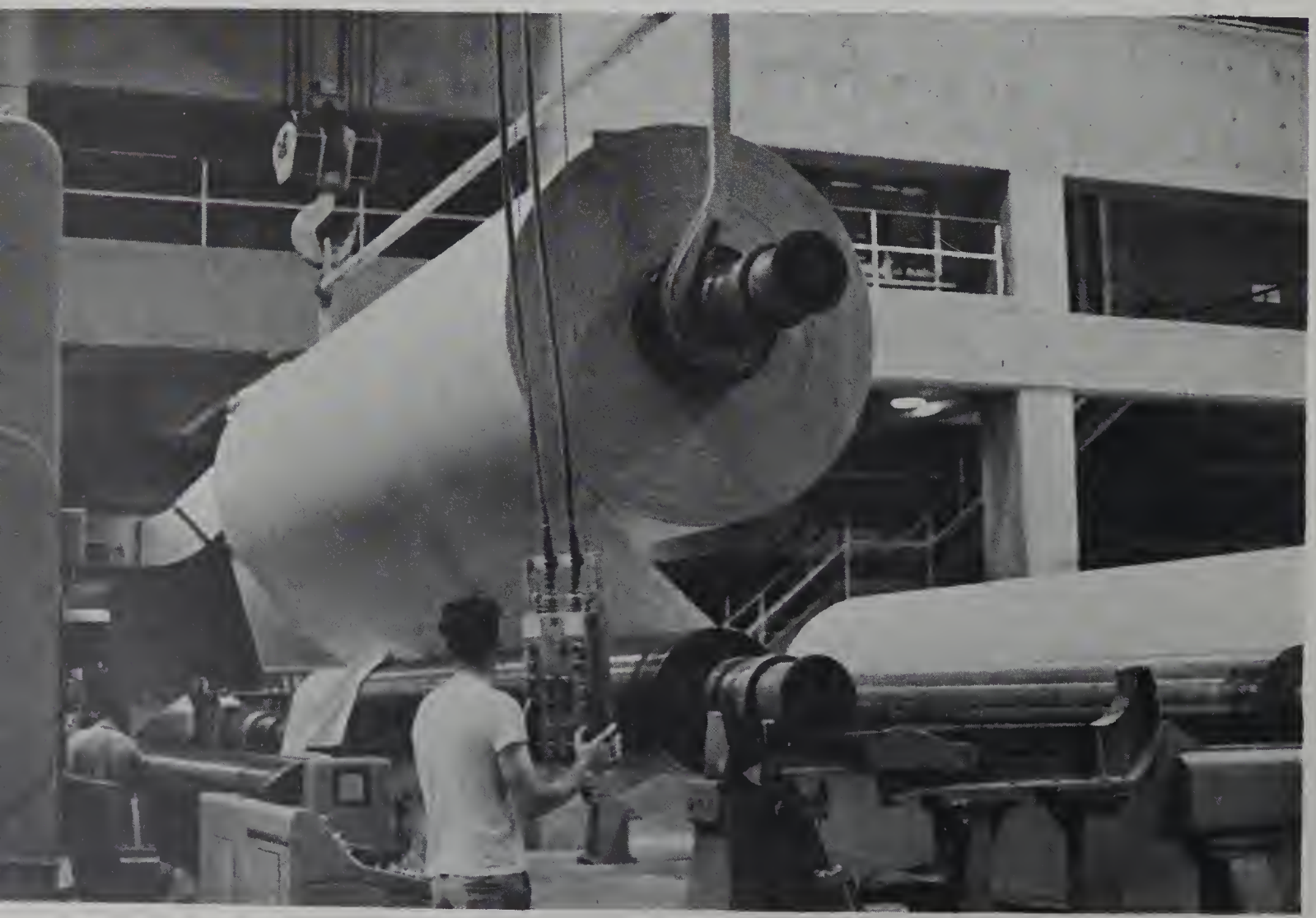
What do you think the "posts" running the length of the mill are for? What would you have to do if anything went wrong with the machine at any point? Would you have to stop the whole machine? Why?

6.

How many men can you see at work in this picture? How is this machine controlled?

Figure 26 is the same machine as that shown in Figure 25, but now you see it from the opposite end.

Figure 27



Exercise

1.

Can you guess why the men call this "the dry end" of the machine?

2.

How many men can you see in the picture?

3.

About how wide is the roll of paper at this end?

4.

What do you think the men working this machine do now with the roll of finished paper? Does Figure 27 answer this last question for you?

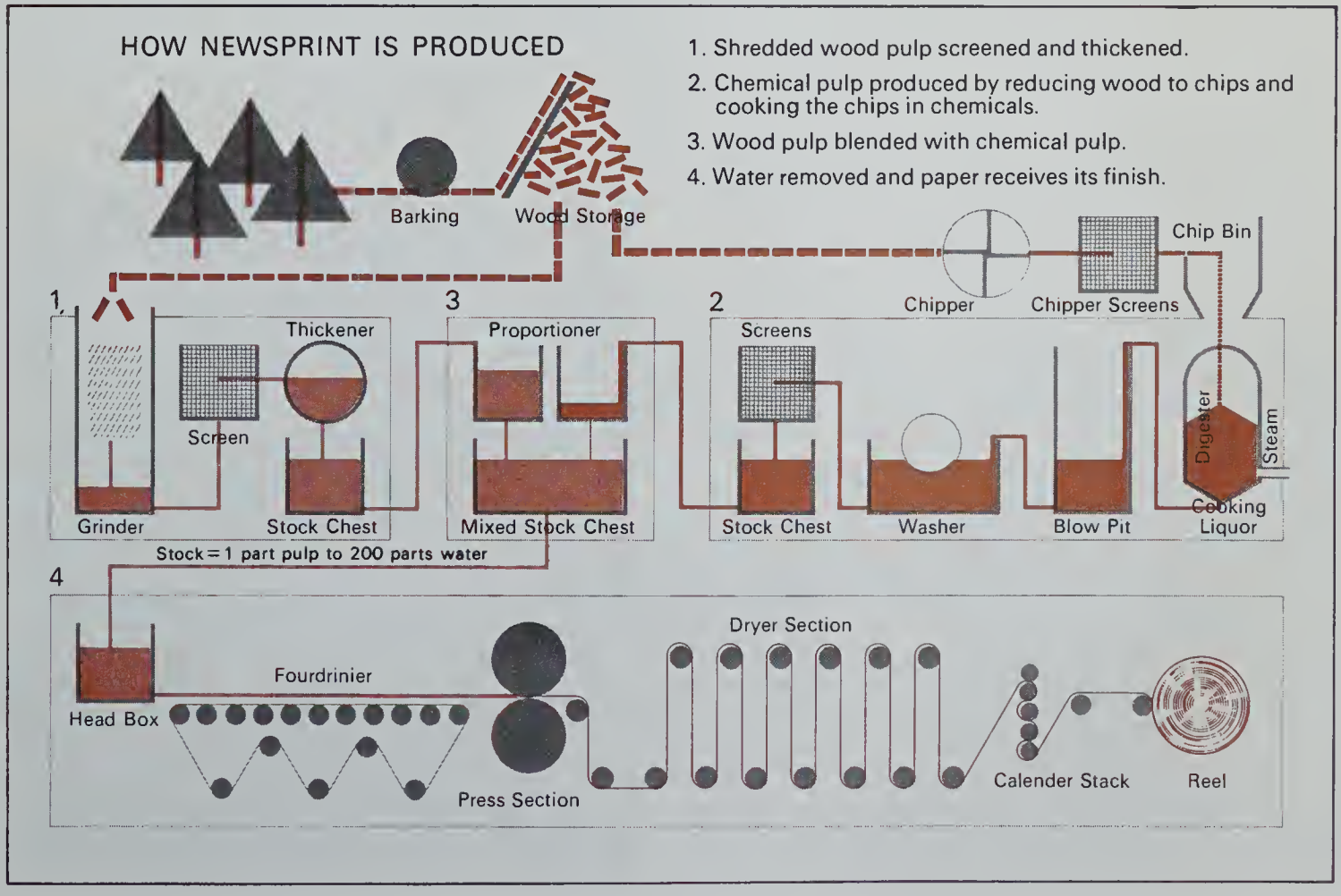
WHAT DO YOU KNOW? . . . that the newsprint machine we have seen at work is more than 300 feet long, and that it converts a 26-foot wide stream of pulp into finished newsprint at speeds up to 30 miles an hour?

The Whole Process

Exercise

Look carefully at Figure 28. You have seen parts of this diagram before. Look at pages 25 and 27.

Figure 28



V On the Move

Distribution and Use

Now that we have seen the manufacturing process itself, it is time to discover what happens to the paper. Men using hoists lift the 26-foot rolls off the end of the newsprint-making machines. Other men cut the full rolls into sizes required for the printing presses. These are of various sizes, and if you look at Figure 29, you see Mr. Hartt standing beside some of the rolls in the warehouse. How wide must these rolls be if Mr. Hartt is about six feet tall? In this picture, too, you see the fork-lift loader about to carry a roll into a railroad truck which is drawn up alongside a platform inside the warehouse. Much of the paper produced here leaves the mill by road, but much also goes southwards along the Pacific coast by sea. The Nootka Carrier shown in Figure 30 is a barge which can carry more than 7,000 tons of paper.

Exercise

Look carefully at Vancouver Island on a large map. Can you see from this how the Nootka Carrier might have got its name?

Tugs tow this barge and others like it direct to the chief coastal towns of California, where paper is in great demand.

Exercise

Look at your atlas map and try to work out how many miles this barge must travel between Port Alberni and say, Los Angeles.

If you could walk around the great warehouse of the Port Alberni mill, you would see rolls of paper waiting to go to places all over the world. One lot, for example, will be marked BOMBAY, and will also carry the warning USE NO HOOKS.

Figure 29

Exercise

How do you think that paper would be carried to Bombay and why should it carry that warning concerning the use of hooks?

Many countries must import newsprint because they do not possess that abundance of soft wood, water, and electric power needed to make newsprint, or else wish to strengthen their own product (which may be made from such sources as sugarcane fibres), with the long, strong fibres of soft-wood. These countries can, however, "finish" paper which has been roughly or partly made. The Port Alberni mill supplies some of this "raw material" in the form of thick paper called "pulp". Chemical pulp is processed and felted on a machine quite similar to a paper machine, into a mat of fibres resembling thick, rough paper or cardboard which is cut into sheets, weighed, and squeezed by huge presses into bales so that the pulp will take up as little space as possible in a ship's hold. The bales are wrapped in a layer of "pulp" and then bound securely with steel wires.

Figure 30

IV Another Side of Pulp and Paper Making

Safety in the Mill

As you study the next few sections, try to imagine that you are the owner of a pulp and paper mill. These are some of the things that a mill owner must be aware of.

We took Mr. Hartt away from his work for a few minutes to show us the big *safety record board* (Figure 31) which stands at the entrance to the mill. How long is it since someone working in the mill suffered an accident? You will notice that no department is listed as having a "lost-time" injury during the month. Is this what you would have expected from the other records? You will see that both the man and the woman pictured on the board are wearing **safety** helmets.

Exercise

1.

Why do you think they are made to do this?

2.

Can you think of other items of clothing or footwear which might be specially made to protect the wearer against injury while he is working in the mill?

3.

Does your father wear clothing designed to protect him at work or at home?

4.

If your mother goes out to work, does she wear such clothing?

The company would have to be prepared for an occasional accident, wouldn't it?

Exercise

1.

How would it prepare for these?

2.

What kinds of equipment would it supply and keep in good order?

3.

How might some of the workers themselves be specially trained to deal with accidents?

4.

In this mill a first aid attendant is on duty at all times. Ask your father what he must do if he injures himself — even if only slightly — at work. Why must he do this?

Do you think fire might be a risk in a mill like this?

Figure 31

5.

If you were the manager, what measures would you take to protect the mill and workers against damage and injury by fire? (Does the Principal of your school have to consider your *safety?)*

6.
Would there be any special hazards in a mill like the Port Alberni pulp and paper mill?

Turn back to page 20 if you need help in answering this question.

The Port Alberni mill has a Management-Union Safety Committee which meets regularly to discuss ways of preventing accidents. It considers any accident which does occur and tries to find some way of preventing a similar accident from occurring again. The mill has its own fire-fighting equipment and every person employed here has a particular job to do if the fire alarm should ring. This might be as simple but important a job as making sure that a certain door is shut or a certain valve closed.

Preventing Pollution

The Port Alberni mill stands in beautiful natural surroundings. It would be sad if it allowed harmful materials used or produced in making paper to escape into the air or the water. How does the Company guard against this possibility?

By this time, the company has spent about $10,000,000 on pollution control in the Port Alberni mill alone. An important part of this work is to make sure that water from the mill is thoroughly cleaned and oxygenated before it drains back into Alberni Inlet. You will remember that the Tyee salmon come up the Inlet to spawn in the rivers and correspondingly, young salmon must find their way down the Inlet to the open sea. The salmon would not be alone in being affected by harmful substances in the water. Trees growing at the waterside, piles built into the river to support wharves and quays, birds resting on the water, even men, women, and children living beside the water — all would be harmed. The company must then — and it does — give a great deal of thought and money to preventing pollution of the water.

The bark burned in the mill can produce what is called "fly ash". Precipitators built into the smoke stacks prevent most of this from escaping into the air; even so, the company is now putting in additional precipitators. When these are working, the treatment will meet the most stringent air pollution control regulations in existence anywhere in North America.

We have learned the hard way that we must not use up or thoughtlessly spoil the things which Nature supplies — forests, soil, pure water, clean air — because we are in a hurry to make as much of this or that as cheaply as we can. We must protect our natural surroundings in every possible way, and if necessary, refuse permission to chop down forests, break up the soil or build factories where we know that this would so damage the surroundings that we could never again restore them.

Research and Development

In these days of rapid change, an industry as big as the pulp and paper industry must undertake research into all its many activities. At one end, it must study ways of improving its supplies of raw materials in the forests. In Figure 32 we see a forest research

station where trees are grown from seeds. These small seedlings are then transplanted in forest areas where most of the trees have been cut down. At the other end, it must explore ways of making new kinds of paper and new uses for it. In between, it must do all it can to make better and more efficient use of its men, machines, and materials. In studies of these and similar matters, the company each year spends millions of dollars amounting to as much as five percent of its total expenditure.

The mill in Port Alberni has a laboratory which carries out hundreds of "routine"

Figure 32

tests week by week. For example, it tests the strength of standard size strips of paper. Some papers — for example, those used on high speed presses — must stand up to greater strains if they are to suit the printers. Again, laboratory technicians take samples from beater tanks and digesters so as to see what proportions of certain substances they contain. These technicians would also analyse water drained from the slurry on the paper machine to find out whether it could safely be discharged into Alberni Inlet. You can probably think of many activities described in this book which chemists in the laboratory would have to check continually. In general, we may say that scientists employed here are concerned with "process and quality control".

In Figure 33 a minute cross-section of wood is magnified and projected on a screen for group viewing and discussion. You can see some of the types of cells which form wood. Seen in vertical sections the cells would appear long and thin.

The laboratory in Port Alberni is, however, supported by laboratories elsewhere in British Columbia. These are not concerned with carrying out routine tests; they are engaged in research into new ways of doing things. Foresters, for example, want to measure the growth of trees more accurately so that they can forecast more accurately how much wood they can "harvest" in a certain area at a certain time. Again, they want to know whether trees found in other parts of the world would grow where the "native" trees of British Columbia will not grow. They ask also, How shall we harvest our trees? What new tools do we need? In particular, they must ask, How can we control the fires which destroy almost half a million acres of trees each year in British Columbia alone?

Meanwhile other scientists investigate the properties of wood. What loads will it carry?, they ask, and, How can we make it more resistant to fire and weather? Their colleagues in other laboratories are interested in the making of new grades and qualities of papers. These range all the way from moisture- and grease-proof bags suitable for garbage disposal to paper dresses in the latest fashions. The search for cheaper and more efficient ways of making paper, plywood, panel board and so on is never-ending. In the long run, what the biologists, chemists, physicists, and engineers discover will alter the work of a mill like that in Port Alberni. This must keep up to date if it is to hold its place among others producing pulp and paper.

In the last few sections, we have talked about safety, pollution, research and development, and the size of the pulp and paper industry in Canada.

Class Project

If you were a mill owner, what sort of safety rules would you try to make those working for you observe? In what phases of the production of pulp and paper could pollution be a big problem? What kind of research and development might you undertake?

Figure 33

VII An Overview

Forests

The forests of Canada cover 1¾ million square miles. They extend in an unbroken belt from the Atlantic to the Pacific. The width of this belt is from 600 to 1,300 miles. As the whole area of Canada is not quite 4 million square miles, you can calculate roughly what proportion of the country is forested. When you know this, you may be less surprised to learn that the value of newsprint exported from Canada is greater than the value of the wheat exported, and that forest products are by far the most valuable of all Canada's exports. The manufacture of pulp and paper was for many years Canada's leading industry, and even now it stands first in total wages paid and money invested. Canada is second only to the U.S.A. in the production of wood pulp. In British Columbia alone there are 47 factories making paper or paper products. These employ more than 10,000 men — almost a ninth of all men employed in manufacturing in that province.

The figures in the next column show the values of the chief exports of Canada in 1967.

		Millions of $
Forest products		2,007
Newsprint paper	955	
Wood pulp and similar pulp	543	
Lumber	509	
Metals		1,343
Copper and alloys	494	
Nickel and alloys	433	
Aluminum and alloys	416	
Motor vehicles and parts		1,730
Wheat		734

You will see from the figures that newsprint accounts for 47 percent of the value of all wood products exported from Canada. Most of this goes to the United States, and as we saw, a great deal of that produced in Port Alberni goes in barges south along the Pacific Coast.

Exercise

By looking at the figures, can you say what percentage of the total of forest products exported is provided by wood pulp?

	International		Coastwise		Total
	Loaded	Unloaded	Loaded	Unloaded	1968
Port Alberni	817	37	16	746	1,617
Vancouver	20,533	3,657	20,977	21,043	66,211

Compared with Vancouver, Port Alberni is only a small port. Look carefully at figures given above (in thousands of tons).*

Exercise

Try to answer these questions.

1.
Why do you think Port Alberni unloads so little coming from abroad and yet LOADS so much going to other countries?

2.
Why do you think Port Alberni loads so little to go to other ports along the coast, and yet UNLOADS *so great a quantity of material* coming from along the coast?

3.
What do you think makes up most of the cargoes coming into Port Alberni from along the coast and most of what goes out of Port Alberni to other countries?

4.
About how many times bigger is the trade of Vancouver than that of Port Alberni? Again, can you think why Vancouver is so much bigger than Port Alberni? Is it just a matter of size of the harbour?

**Adapted from the* Canada Year Book *1968, p. 822.*

Paper Mills Elsewhere

The makers of pulp and paper must consider carefully where they will build a mill as big as that in Port Alberni.

Exercise

If you were going to build a new pulp and paper mill in north-western Canada, where would you choose to place it?

Would you like some help with that question, because it is more complicated than it may seem at first?

A manufacturer proposing to build a mill would certainly consider the following:

1. What raw materials, including land and water, does he need? (In the case of making pulp, what two raw materials would you have to have in great quantity?)

2. The manufacturer then asks, How am I going to drive the machines in my mill? Shall I need much power and how shall I get it? — by burning coal, or oil, or by hydro-electric power? (Does a factory making paper use much power? If so, the cheaper it is, the better for the manufacturer!)

3. The manufacturer also considers this question — Would it be better to put my mill near to the raw materials or near to where I hope to sell what I make? If he needs only small quantities of material — as he would if he were making watches! — then he can put his factory near to where he will sell the finished goods. However, if he needed great quantities of raw material to make something smaller and more easily transported, then he would be wise to put his factory near to supplies of raw materials, wouldn't he?, and carry the less bulky more valuable finished goods to the market. (Would this last be the case in making paper, do you think?)

4. A manufacturer can't make things, even with modern machinery, unless he has MEN (and perhaps women) to operate his machines for him. He will find it easier to get workers if the factory is near a big centre of population—which is also where he might sell some of his goods. However, he might still feel that reasons for putting the factory near to where he can get his raw materials — even if this is in a desert or deep in a forest — are so strong, that he had better build a town and persuade workmen to move into it.

5. One other small matter. The manufacturer will probably need some millions of dollars, especially if he is going to build a town! How would you get that much money? (I *suppose* you would have to borrow it and the people who are most likely to lend it to you are those who know what kind of business you hope to do. In a city like Vancouver, bankers, insurance brokers, and other businessmen would know whether the mill you wanted to build and what you wanted to make in it would prove to be profitable or not.)

Exercise

Consider this mill you are going to build. How will you get the men and women who will work in it for you?

In the left hand column of the table on the next page is a list of the five M's — Materials, Motive Power, Markets, Men, Money — which you have to consider before you decide where to build your mill. Opposite each of the Five M's is a sentence or two. Each sentence contains at least one numbered pair of brackets, like this — (8——). Which of the words on the list on the right of the questions would you choose to complete best that part of the sentence? *Write the numbers 1 - 12 on a piece of scrap paper and against each number write the word you would put into that numbered pair of brackets.*

Exercise

Where, then, will you build your *mill?*

Wherever in the world we find pulp and paper mills, they are always near abundant

Needed for My Pulp and Paper Mill

MATERIALS	The two materials I shall need are (1———) and (2——— .) The first of these is (3———) and difficult to carry about. So I shall most probably put my mill near to (4——— .)	sulphite, plywood, softwood: water, cotton, grass: light, breakable, heavy: a big town, a forest, a mountain
MOTIVE POWER	As I shall need (5———) quantities of power, I should choose (6———) if I could get it. I could hope to get this in a region with many large rivers and (7——— .)	great, small oil, coal, hydro-electric power plains, lakes, icebergs
MARKETS	Men and women make up the market in which I must sell my pulp and paper. I should build my mill as (8———) as possible (to) (from) my markets. If, however, I have to carry the pulp and paper I make any distance, then I would put my mill on a(n) (9———) line of transport to my markets.	near, far easy, costly, difficult
MEN	I guess now that I must put my mill close to my supplies of raw materials where (10———) people live. This means that I shall have to build a "town" for them to live in.	many, few, native
MONEY	I shall have to borrow a great deal of money and for this I should go to bankers in a city like (11———) where the making of pulp and paper is (12———) known.	Calgary, Vancouver, Winnipeg not, slightly, well

supplies of water and wood. Soft wood provides the greater part of the world's wood pulp. Softwood trees grow best in cool regions of fairly heavy rainfall, and they are usually to be found in areas crossed by many rivers and dotted by many lakes. Vast quantities of water are used in pulp and paper mills. The mills also need great quantities of power which can usually be provided by hydro-electric stations built along the rivers or where the rivers leave the lakes.

The wood used in paper-making is a heavy bulky substance, difficult to transport, but the paper into which it is made is much more compact, and, to this extent, easier to transport. The manufacturer therefore places his mill within the forested area so as to reduce the cost of getting his raw materials. At the same time, he must transport the paper which he makes as cheaply as he can to his markets. He may therefore

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build

a branch-line (often called a "spur") to the main railway or put in wide all-weather roads to be used by a fleet of trucks.

The forests producing softwood for paper-making are thinly peopled and the manufacturer may have to develop a town close to his mill for his workers to live in. Men will not come and work for him unless they can have homes, schools, stores, churches, and facilities for skating, boating, fishing, curling, and so on.

Understanding what goes on in Port Alberni helps us to understand how and where much of the world's paper is made. Meeting Mr. and Mrs. Hartt, Janet and Brian, helps us to meet also thousands of other families who live near or within the great softwood forests of the world.

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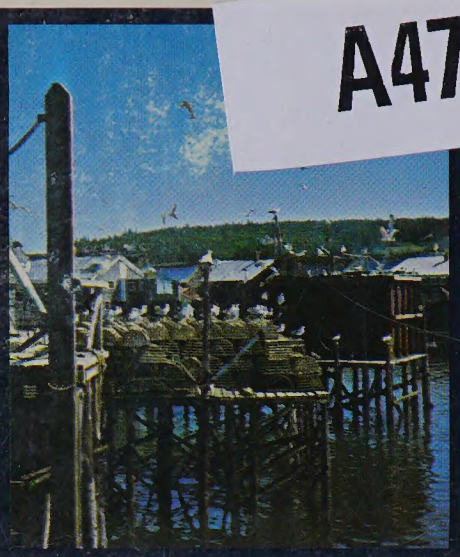

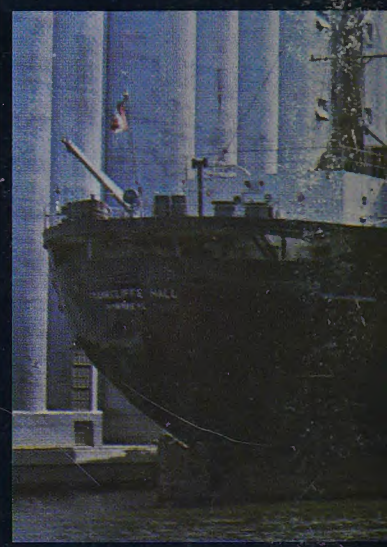

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